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Adjustment to spinal cord injury (SCI):

The role of psychological resources

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Content

1. Background

1.1. Spinal cord injury

Spinal cord injury (SCI) is a health condition with severe life-changing consequences on a physical, social and psychological level [1, 2]. SCI is a trauma or damage to the spinal cord which can occur through traumatic or non-traumatic events. Most frequently occurring traumatic causes for SCI are motor vehicle accidents and falls. Non-traumatic causes can be, for example, internal bleedings or cancer. Persons affected by SCI are predominantly male, the incidence of SCI increases with higher age [1, 3].

SCI is a neurological condition, which results in permanent loss of motor and sensory function corresponding to the level of the spinal lesion. It affects bladder, bowel, sexual, and autonomic functions [4, 5] and can cause spasticity [6] and pain [7]. Physical secondary conditions, such as pressure sores, urinary tract infections, cardiovascular disease, pulmonary complications, or osteoporosis are frequently reported, and cause additional burden to the persons concerned [8-12].

These severe physical consequences also reverberate on the level of everyday activities as well as societal participation [13-15]. Hand and arm use can be impaired, leading for instance to limitations in eating, drinking or self-care such as washing oneself, toileting or looking after one's health. Limitations in mobility-related activities such as walking, driving, or changing body positions can be additional consequences. Work and leisure activities such as visiting friends or travelling are frequently negatively influenced. Overall, these limitations may make work re-educations, structural measures at home, adaptations of the own vehicle, or usage of specialized transport services necessary and require increased efforts by the affected persons. Although environmental adaptations are possible in many domains, barriers such as the accessibility of buildings or public places can remain a major problem and source of frustration.

SCI may also exert a negative impact on mental health. The risk for major depression, anxiety disorder, posttraumatic stress disorder, substance abuse, and suicide is elevated for people with SCI compared to the general population [16-21]. The challenges connected with SCI can also result in severe stress

experience [22], which in turn can further reduce health and well-being [23, 24] and influence the onset and progression of secondary health conditions [1, 25, 26]. Overall, good mental and physical health, highest possible levels in quality of life and participation are key rehabilitation goals [27].

SCI imposes a high burden on the affected person, but also on the caregivers who give various kinds of support such as preparing meals or outdoor transportation. A considerable proportion of partners of persons with SCI perceive high levels of caregiver burden [28]. SCI also constitutes a significant economic burden to society. For example, estimations conducted in the USA of direct medical costs, disability support and productivity loss due to SCI sum up to about 20 billion US dollars per year [29].

SCI is a comparatively rare health condition. Per year, 25 to 83 people per million inhabitants sustain an SCI in North America [30]. In Europe, the incidence rate ranges in France around 19.4 [31], in Italy 14.3 [32], in Germany 36 [33] per million inhabitants a year. Robust epidemiological data on SCI is missing in Switzerland; however, the total population has been estimated between 2,000 and 4,000 persons [34].

1.2. Psychosocial adjustment to spinal cord injury

Adjustment to disability is "an evolving, dynamic, general process through which the individual gradually approaches an optimal state of person-environment congruence" [35, p. 8]. In SCI literature the term "adjustment" has been defined as "a person with SCI responding adaptively to their injury, that is, modifying their behaviour, thinking and personal circumstances in relation to the many factors associated with the injury and impairment, with a goal of achieving a satisfactory quality of life" [36].

The terms "adjustment" and "adjustment outcomes" will be differentiated in the current doctoral thesis. With the term "adjustment" I will refer to the whole adaptation process after SCI, which corresponds with the above definition of adjustment. "Adjustment outcomes" will be operationalized through the levels of mental health, perceived stress experience, participation and quality of life. High quality of life and participation, good mental health or low levels in perceived stress experience will be used as indicators of "good" or "positive" adjustment.

These adjustment outcomes represent essential rehabilitation outcomes. To support persons with SCI and to facilitate the achievement of the best possible adjustment to the injury is the ultimate goal of rehabilitation. Focusing on the adjustment process and its underlying mechanism is a primary concern because it lays the ground for the development of interventions: persons with SCI can only be adequately supported if it is known how the adjustment process after SCI works.

1.2.1. Early SCI adjustment models - Stage models

SCI adjustment models describe how persons adjust to their injury. Early adjustment models proposed a stage-like adjustment process. These models postulated a linear progression through a fixed set of stages which would be experienced by every person with SCI. Typically, these stage models describe an initial stage of shock, followed by distress and concluding with acceptance of one's life situation [35, 37-39]. However, stage models were rejected because the recurrent nature of adjustment was not sufficiently taken into account, i.e. individual differences in the adjustment process, could not be explained with these models [20, 39]. Other stage-like models incorporated this criticism by proposing stages without a fixed order, considering that not every person necessarily experiences all stages when adjusting to disability [40, 41]. Currently, how a person adjusts to SCI is seen as a dynamic, recurrent process and not a stage-like process.

1.2.2. Recurrent SCI adjustment models

Recurrent models view adjustment to SCI as continuous process where despair or acceptance can re-emerge [39]. In these models various factors interact and together determine the adjustment outcomes after SCI. More concretely, prevailing models stress the role of psychological, biological, and environmental factors in determining adjustment outcomes such as quality of life, mental health or participation via appraisal and coping processes [2, 20, 36, 42]. Adjustment outcomes, in this sense, are the result of a multifactorial process. This result,

however, is not stable, but constantly being influenced by, but also re-influencing, the prior factors (i.e. the psychological, biological, and environmental determinants as well as the appraisal and coping processes).

Two SCI adjustment models will be briefly outlined. They are largely based on the Transactional Stress-Coping Model by Lazarus & Folkman (1984). This influential model originating in stress research will thus be presented first.

1.2.2.1. The Transactional Stress Coping Model

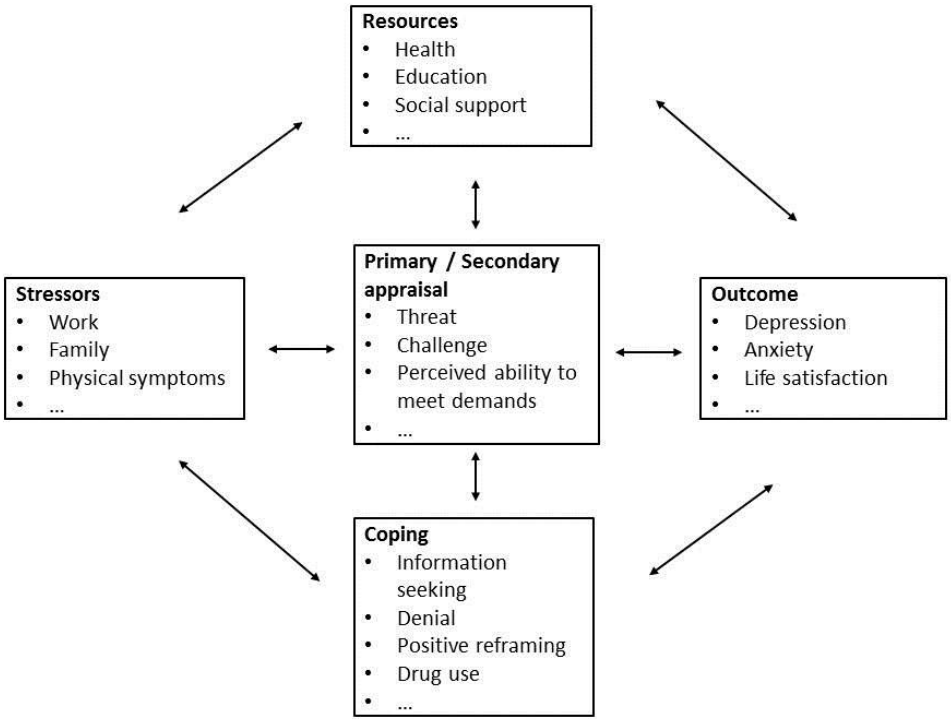
The Transactional Stress-Coping Model postulates that stress experienced by a person is the result of an interaction between the environment, i.e. a specific situation, and an individual dealing with the situation. Stress is defined as a "particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" [42, p.19]. Therefore, a person's subjective appraisal of a situation leads to stress, and not necessarily the objective characteristics of that situation.

Stimuli eliciting stress are called stressors. The evaluation of a stressor occurs in a two-step process: Primary appraisal is the cognitive evaluation of a stimulus, which can have a positive, neutral or negative valence. Stimuli with positive or neutral valence pose no potential danger at all and, therefore, do not represent stressors. Negatively appraised stimuli, however, can represent a potential danger to the person and are appraised as potentially harming, threatening or challenging. Secondary appraisal refers to the belief whether the stressor can be handled and whether necessary resources are available to accomplish this endeavour. How a stimulus is perceived influences how a person copes with it, i.e. which efforts and behaviours are used to manage the demands (coping). Lazarus & Folkman (1984) differentiated two broad types of coping reactions: problem-oriented and emotional-oriented coping. Planning and actively trying to solve a difficult situation, i.e. the stressor, constitutes a problem-oriented coping approach. Handling the emotions aroused by and connected with the stressor, is seen as emotion-oriented coping. How a person copes then influences the situation, which is again reappraised in order to evaluate the success of the used coping strategies.

1.2.2.2. Specific SCI Adjustment models

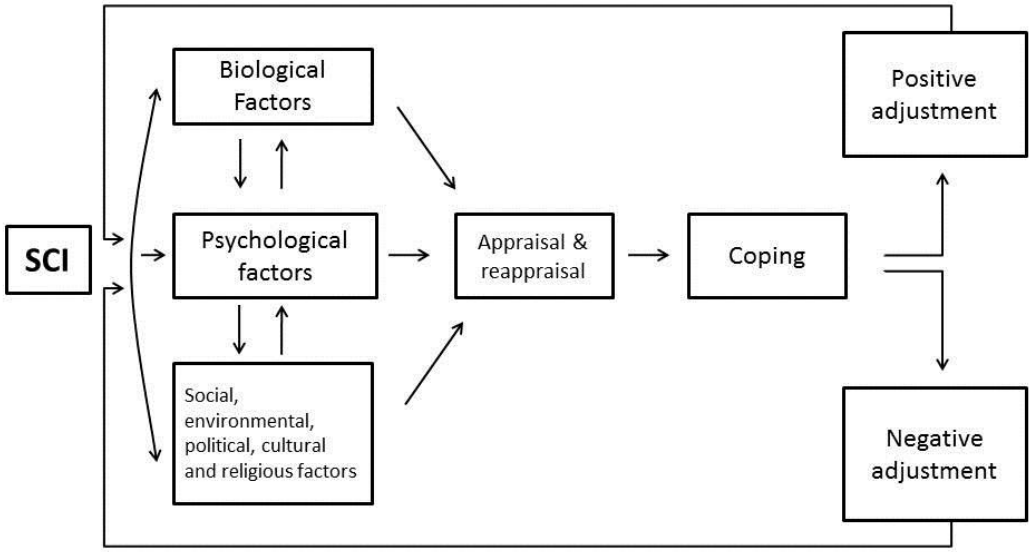
The Stress Appraisal and Coping Formulation of emotional adjustment to SCI Model (SAC) was established to explain emotional adjustment, i.e. levels of depression or life satisfaction, after SCI [20]. The onset of SCI encompasses several potential stressors, such as pain, physical impairments, or participation limitations and initiates a stress response. Primary and secondary appraisals, coping as well as resources are the model components influencing the magnitude of the emotional reaction after SCI. Whether a person appraises SCI as a dangerous threat or a challenge to be dared (primary appraisal) and whether someone believes to have the ability to meet the demands imposed by SCI (secondary appraisal) mediates the impact of SCI. Resources such as social support, age, education or health, as well as coping styles are further important mediating factors. Each component of the SAC is bi-directionally associated with all other components, emphasizing the complex interplay between all variables associated with adjustment to SCI (Figure 1).

Figure 1. Stress appraisal and coping formulation of emotional adjustment to spinal cord injury (SAC).



The SCI Adjustment Model (SCIAM) basically employed the SAC, but explicitly incorporates biological, psychological and social factors as further adjustment determinants and does not depict emotional adjustment as only outcome following SCI [36]. Psychological factors may comprise personality or attitudinal characteristics of a person. Psychological resources are included in this component. Biological factors may include the neurological damage, level and completeness of the lesion. Factors such as the health insurance system, the architecture of buildings and roads, social support, cultural and religious beliefs of the population reflect important environmental determinants of adjustment to SCI (Figure 2).

Figure 2. Spinal Cord Injury Adjustment Model (SCIAM).



Biological, psychological, and environmental factors influence primary and secondary appraisals. Coping depends upon how SCI is cognitively appraised. Finally, the adjustment outcomes are a result of these prior coping processes. Because this process is cyclical, the adjustment outcomes can change "for the better or worse depending upon the processes occurring" [36, p. 33].

There is one main difference between the SAC and the SCIAM. A double mediating mechanism is hypothesized in the SCIAM: stressor –> appraisal –> coping –> adjustment. The mechanism in the SAC is less clear, as one to three

components (appraisals, coping, resources) are assumed to potentially mediate adjustment simultaneously, sequentially or independently.

To sum up, adjustment to SCI is a complex multifactorial process. Psychological factors including psychological resources, environmental and biological factors, appraisals and coping are essential components of the adjustment process. They interact and act as determinants of the adjustment outcomes. Thus, the psychological resources a person relies on, facilitators or barriers from the environment and biological factors together influence how a person appraises SCI, how a person copes with SCI and consequently how a person is doing.

1.3. Psychological resources

In this doctoral thesis, psychological resources are defined as inner, health protecting and health promoting potentials of a person, which are centrally valued in their own right or which represent a source or means to deal with difficult situations or obtain valued ends [43-46]. They may include abilities, skills, knowledge, experiences, talents, strengths, and behavioural patterns of the person.

Hobfoll (2002) states that the term "resource" should only include characteristics which are "held as resources for a wide range of people who share a set of cultural traditions" [46, p. 307]. This distinction is necessary to prevent an exceeding use of the term resource, which otherwise could incorporate all characteristics of a person. Scientific evidence is needed to show the beneficial impact of a variable across a wide array of situations. However, in cases where empirical research is comparatively rare (e.g. regarding concepts such as curiosity or musicality) the beneficial influence across a wide range of persons and situations is rather assumed than proven.

Self-efficacy and purpose in life are examples for psychological resources which have received extensive scientific support with regards to their beneficial impact across a wide array of situations [46]. Self-efficacy is defined as a conviction or belief that one can successfully execute the behavior required to produce a given outcome [47]. Strong self-efficacy beliefs determine a person's well-being in many ways, for example by approaching difficult tasks as

challenges, maintaining stronger commitment to goals and showing perseverance in trying to attain these goals [48]. Purpose in life is the degree to which an individual finds meaning in life [49]. The concept of purpose in life is closely tied to Victor Frankl who posited that striving to find a meaning in life is the most powerful force in humans [49]. It is by having something to live for that persons are able to overcome even most horrifying situations and maintain, for example, sound levels in mental health.

Psychological resources such as self-efficacy and purpose in life are frequently measured with self-report questionnaires, where items are answered by study participants on a standardized response scale. For example, the item "I am confident that I could deal efficiently with unexpected events" of the General Self-Efficacy Scale by Schwarzer & Jerusalem (1979) can be answered on a 4-point Likert scale ranging from 1 (not at all true) to 4 (exactly true). The use of reliable and valid measurement instrument is an essential precondition in order to convincingly report precise estimations and changes within the measured variable and associations with other variables. For this reason the psychometric properties of one of the most widely used measurement instruments for self-efficacy, the General Self-Efficacy Scale [50], will be examined in one study of the current doctoral thesis.

Even though one can infer from the SCIAM that psychological resources and their interaction with the other factors of the adjustment process such as appraisals and coping play a key role, the underlying mechanism remains unclear, as evidence with regards to psychological resources is fragmented and weak at best [20, 51]. Also, studies exemplifying how to target and integrate psychological resources in the rehabilitation process and describing the impact of such an approach for the patient are needed. Findings of such studies would support psychological clinical practice in which strengthening psychological resources is part of the daily routine [52]. For that purpose I will study how psychological resources can be integrated and used to reduce the stress experienced by a patient in the clinical rehabilitation setting. I will further examine the interplay of psychological resources with appraisals and coping and investigate whether and, if so, how they determine the adjustment outcomes quality of life, depressive symptoms and participation.

2. Research questions and objectives

The current doctoral thesis consists of four studies. Alluding to the gaps described in the introduction, the four studies give an answer to the following research questions:

1. What can we learn about the role that psychological resources have in the adjustment process of persons with SCI from the literature?

2. How can psychological resources of a person with SCI be targeted in the clinical rehabilitation setting and do they matter?

3. Can we use the most widely used measurement instrument to assess the psychological resource general self-efficacy in SCI?

4. What is the role of psychological resources and their interaction with cognitive appraisals and coping in the adjustment process in SCI?

Four studies were conducted. Each answers one of the four research questions, respectively. Encompassing the four research questions, the general objective of the current doctoral thesis is to gain an in-depth understanding about the adjustment process in SCI while focusing on psychological resources and their interaction with cognitive appraisals, coping and the adjustment outcomes mental health, perceived stress experience, quality of life and participation.
The objectives of the four specific studies are:

1. To investigate the role of psychological resources after SCI and examine their relationship with other factors and outcomes of the adjustment process. For this purpose a systematic literature review is conducted.

2. To demonstrate the targeted integration of psychological resources in the context of interdisciplinary clinical rehabilitation of spinal cord injury. For this purpose a single case study is conducted with a person with SCI using rehabilitation management tools based on the International Classification of Functioning, Disability and Health [53] during first rehabilitation.

3. To examine the psychometric properties of the General Self-Efficacy Scale (GSES) in spinal cord injury, which will be used in study 4. For this purpose the data of a cross-sectional study are used to evaluate the psychometric properties of the GSES applying Rasch analysis.

4. To examine whether and, if so, how psychological resources interact with cognitive appraisals, coping and the adjustment outcomes quality of life, participation and symptoms of depression. More specifically, I studied the hypothesis generated from study 1, namely, a) whether stronger psychological resources are associated with higher quality of life, lower levels of depression and more participation, and b) whether the appraisals and coping styles mediate the potential impact of the psychological resources on quality of life, depressive symptoms and participation. For this purpose a nation-wide, cross-sectional study is conducted.

In the following, the doctoral thesis is subdivided into five parts. The first four parts represent the four studies, each relating to one of the research questions stated above. In the fifth part the results of the four studies are summarized and discussed from a broader, more general perspective.

3. Psychological resources in spinal cord injury: A systematic literature review

Published article:

Peter, C., Müller, R., Cieza, A., Geyh, S. (2012). Psychological resources in spinal cord injury: a systematic literature review, Spinal Cord, 50, 188–201.

3.1. Objective and specific aims:

The objective of this study is to examine the role of psychological resources after SCI and examine their relationship with other factors and outcomes of the adjustment process. The specific aims are a) to identify the psychological resources studied in SCI research, and b) to summarize the evidence about the relationship of psychological resources with other factors and outcomes of the adjustment process.

3.2. Method and Materials:

A systematic literature review was performed searching Pubmed, PsycINFO, the Citation Index of Nursing and Allied Health Literature (CINAHL), the Social Sciences Citation Index (SSCI), and the Education Resources Information Center (ERIC). Search terms for psychological resources were combined with search terms for spinal cord injury ("parapleg*", "quadripleg*", "tetrapleg*", "spinal cord inj*" or "spinal cord*"). Potential search terms for psychological resources were identified by consulting prominent health and health-related models and theories that address psychological resources, and by screening the psychological literature in PsycINFO for articles explicitly mentioning psychological resources in title or abstract. Potential search terms were checked for their correspondence with the definition of psychological resources to decide on their final use in the search strategy.

Search results were screened for eligibility by two reviewers independently from each other, solving disagreement by consensus. Quantitative studies

published in a scientific journal between 1990-2010 in English and mentioning psychological resources in the study aim, assessing psychological resources, or administering an psychological resource-based intervention were included for further analysis. Studies involving persons with SCI younger than 13 years, including non-human samples, and not generating first-hand data on psychological resources were excluded. Also, reviews, meta-analyses, dissertations, psychometric studies, case reports, and qualitative studies were excluded.

From the included studies, information about the study aims, design, and population were extracted. All variables assessed in the study and the corresponding assessment instruments were identified. Among the study variables, all psychological resources were marked specifically and study results about psychological resources were documented. For quality assurance, data extraction and study quality rating (see below) was conducted by two reviewers independently from each other in one third of the articles, solving disagreement by consensus. Data extraction was conducted using an MS-Access database.
The identified psychological resources were listed and grouped. Research results were synthesized for each group thematically, subdivided by groups of associated variables representing outcomes and factors of the SCI adjustment process. Results were summarized considering the significance, direction, and the consistency of the associations, study methodology and strengths of evidence.

Study quality was rated using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement [54] or the Physiotherapy Evidence Database Scale (PEDro)[55]. The STROBE represents a checklist of 22 criteria for case control, cohort and cross-sectional studies. The PEDro scale consists of 11 items to be applied for randomized controlled trials. For both scales the number of fulfilled criteria was counted.

3.3. Results

The literature search identified 1530 articles, 83 were included (Figure 3). The agreement between the reviewers was 92% in the paper selection, 69.7% for variables, 76.4% for results, 91% for study quality in the data extraction.
Study characteristics as well as demographic and lesion-related data of the study populations are depicted in Table 1. Overall, 92 different constructs representing psychological resources were captured in these studies (Table 2). Forty-eight of the search terms used were not identified in the literature search (e.g. curiosity, humor or creativity). Psychological resources were structured into 7 overarching groups and both statistically significant and not significant results considered (Figure 4). Statistically significant results are presented in Tables 3 to 6.

3.3.1. Self-efficacy and perceived control

Self-efficacy (SE) and perceived control (PC) are defined as the person's beliefs or general perceptions to direct or perform a behavior [47, 56]. Overall, 7 studies assessed general self-efficacy (GSE), 12 studies self-efficacy related to health conditions or -management (HSE) and 6 studies self-efficacy related to other specific contents (e.g. exercise). PC was assessed in 17 studies. Measurement instruments used are shown in Table 2.

3.3.1.1. Quality of life, well-being and life satisfaction

The evidence for the relation of SE with well-being seemed fairly strong. Persons with high GSE, social self-efficacy or PC reported higher well-being [57-59] and life-satisfaction [57, 60, 61]. The results regarding perceived health were inconclusive [57, 58, 61]. HSE, but not GSE predicted quality of life in a multivariate longitudinal study [62]. However, HSE's association with quality of life [62-64] and perceived health was inconsistent [64, 65] and may be explained by differences in the study populations.

3.3.1.2. Physical health

Only a few studies addressed the relation between SE and physical health, and the evidence appeared to be weak. People with higher HSE had less physical impairment [66] and less secondary physical conditions [67, 68]. PC over

pressure relief did not predict health behavior for pressure sore prevention or pressure sore occurrence. Although, sample size of this longitudinal study was low (n=17) [69]. An inverse relation of exercise self-efficacy and breathing problems was reported [70]. Studies suffer from potential problems in sample representativeness and measurement robustness.

Pain may affect SE, however evidence seems weak and is based on few studies. Pain self-efficacy was higher for persons with SCI than for pain patients without SCI [64]. Persons with SCI and pain experienced lower HSE and exercise self-efficacy than persons without pain [65, 70]. High pain control was associated with less pain interference [71, 72] and lower pain intensity [72], while inconsistent relationships of SE with these variables were found [64, 65, 70, 73].

3.3.1.3. Mental health

The associations of SE with mental health are the most consistent identified in this review. Persons with high GSE, HSE or pain control were consistently less anxious or depressed [64-66, 70, 73, 74] and reported better mental health [71, 72]. However, these studies were cross-sectional and statements about the direction of relationships or causality cannot be made.

High HSE was associated with lower helplessness [66], but not related with feeling worn out [68], psychiatric history [66] or number of medications [66] in cross-sectional studies. High exercise self-efficacy was related with higher alcohol consumption [70].

3.3.1.4. Activity & Participation

The evidence on the relation of SE with participation is fragmented, as different activity-types were examined. Persons with high GSE, HSE, exercise self-efficacy/mastery or PC performed more school [75], recreation [57] or exercise activities [76, 77] prior or post injury. They performed better health behavior and used less health care services [68], experienced more functional independence and less mobility restrictions [61]. These belief-related resources were related with a higher amount of work activity prior injury [75] and with more time spent on work post-injury [57]. Associations with employment status were inconsistent [58, 66, 68], while the relationship with work impairment was not significant [61]. Social integration [61], participation in SCI-adapted

activities [68] and physical activity were not consistently higher for persons with high PC or HSE in cross-sectional and longitudinal studies [78, 79].

3.3.1.5. Socio-demographic and lesion-related variables

Evidence is fairly strong that SE and PC are not related with socio-demographic and lesion-related variables. Associations of belief-related resources with socio-demographic variables such as education [57, 58, 63, 66, 68, 73], gender [57, 58, 63, 68], age [57, 58, 61, 63, 68, 73, 78, 80], marital status [57, 58, 68, 81], income [57, 58] and ethnicity [58, 60, 68] were largely not significant.

The relationship of SE with lesion-related variables including level and completeness of injury, age at injury and time since injury were mostly not statistically significant [57, 58, 61, 63, 73, 77, 78]. High HSE appears to be associated with greater time since injury [63, 73]. PC was predicted by neurologic impairment one year post-injury in a multivariate analysis [75].

Compared to general populations, persons with SCI reported lower social self-efficacy but equal GSE and PC [59, 82], and higher HSE than persons with multiple sclerosis [66]. Decreases in control and self-reliance due to SCI were retrospectively reported [83, 84], but also increases in SE [85].

3.3.1.6. Interrelations of psychological resources, appraisal and coping

Many different personal and environmental factors have been examined, but results are not comparable across studies and evidence remains weak. Persons with high control or mastery had more knowledge [75] and higher self-esteem [86]. Higher HSE was associated with acceptance [64, 65] and fewer cognitive distortions [66]. GSE positively correlated with perceived manageability. This might be explained by the conceptual similarity of these two variables [74]. A person’s PC at rehabilitation admission predicted PC 1 year post-injury [75].

3.3.1.7. Environmental factors

Interpersonal support was unrelated to PC [61] and inconsistently associated with HSE [68, 73]. HSE was unrelated to environmental adaptations, facility accessibility and denied/unrequested health care services [68]. In-patients needing independent living services reported lower control than others [87].

3.3.1.8. Interventions strengthening SE and PC

Evidence regarding SE enhancement is fairly consistent. Multidisciplinary, multimodal interventions with different topics such as lifestyle or self-relaxation targeting specific SE were successful. GSE and specific self-efficacy, e.g. for active living, were enhanced by active/independent living programs [88, 89], or physical activity or sports programs [74, 79, 90]. HSE was not increased by a cognitive-behavioral pain management program [91], but enhanced in a wellness workshop intervention. However, in the latter study, the enhanced HSE levels of persons in the intervention group did not differ from the HSE levels of the control group [92]. PC was not improved in the identified intervention studies [75, 79, 87]. Overall, sample sizes for SE-intervention studies were small ($27<n<44$), but larger for PC-intervention studies ($37<n<234$).

3.3.2. Self-esteem

Self-esteem refers to a person's positive evaluation of one's self [93] and was assessed in 20 studies (Table 4). Results are fragmented, but suggested relationships of self-esteem with well-being, mental health and participation. Persons with high self-esteem showed higher life satisfaction [86, 94], better sexual adjustment [95], were less depressed [83, 86], less stressed [96] and felt less lonely [94]. Self-esteem was inconsistently related to functional independence [86, 96, 97] and not associated with scoliosis [97], or pressure sore occurrence [98]. High self-esteem was associated with better social integration [96] and related to physical, but not work- or school-related activities [99]. Persons with high self-esteem experienced higher mastery [86] and hope [100] and showed more emotional- and problem-focused coping [96].

Persons with SCI frequently perceived self-esteem as compromised by SCI [83, 101, 102]. However, their self-esteem did not consistently differ from general [82, 86, 103-105] or other clinical populations (n = 16) [106]. Cross-sectional studies indicated that self-esteem could be restored [100, 102]. Longitudinal research reported reduced self-esteem 1 and 2 years post-injury [103, 104]. Self-esteem's association with gender was inconsistent [94, 97, 100]; relations with other socio-demographic [94, 100, 102] and lesion-related variables [99, 102] were not significant. It was also inconsistently related with social support [94, 96, 97, 100], unrelated to social barriers [96], but negatively connected to amount, origin and type of received insurance benefits [98, 99].

Self-esteem and self-affirmation were not enhanced by cognitive behavioral therapy [107] or an educational active living-workshop [88]. However, sample sizes were small in the treatment groups (n = 27; n = 28 respectively) and had only few participants with low self-esteem [107].

3.3.3. Sense of Coherence

Sense of coherence (SOC), defined as global orientation to view the world as comprehensible, manageable, and meaningful [108], was measured in 5 studies (Table 4). SOC was associated with better psychosocial adjustment [109, 110], predicted better mental health [110] and quality of life [111] also in longitudinal studies.

Persons with SCI reported changes in SOC after SCI [110], but higher SOC than able-bodied [112]. High SOC was related to acceptance [110, 111], fighting spirit [111] and less social reliance, loss- and threat-appraisals [111].

SOC of participants of a comprehensive pain management program (n = 27) remained stable over 12 months. In contrast, SOC of persons with SCI in the control group without treatment decreased over time [113].

3.3.4. Spirituality and purpose in life

Spirituality, which refers to searching for or personal attitude towards transcendence, was assessed in 4 studies [114]. Purpose in life (PIL) is the degree to which an individual finds meaning in life [49] and was examined in 5 studies (Table 5).

Associations of PIL and spirituality with well-being and mental health appear significant. However, evidence is weak and based on single studies. High spirituality and PIL were associated with higher life satisfaction and well-being [95, 115, 116], better mental health [115] and adjustment [117] and, as shown in longitudinal research, reduced mortality [118]. Spirituality was not associated with functional independence [115].

Both, cross-sectional and longitudinal studies indicated changes in spirituality after SCI [85, 115], and similar spirituality-levels to persons with other health conditions [119, 120]. One large study reported significant but low correlations of PIL with health locus of control and various personality attributes [117].

Higher PIL was found for men than women [121]. Associations with other socio-demographic or lesion-related variables were statistically not significant [116, 117].

3.3.5. Hope and Optimism

Hope and optimism conceptualized as positive orientation towards the future [122] were assessed in 5 cross-sectional and 2 longitudinal studies [62, 123]. Evidence appears fragmented and contradictory (Table 5). Hope and optimism showed positive bivariate relations with life satisfaction [123], quality of life [62], sexual well-being [95], mental health [124] and functional independence [124]. However, relations were not significant in multivariate, longitudinal analyses [62, 123, 124].

Affected persons perceived optimism as compromised by SCI [83, 84]. Interconnections of hope with education and ethnicity [100], time since mobilization [124] and in- or out-patient status were found [100]. Relations with other socio-demographic or lesion-related variables were not significant [124].

High correlations of hope with self-esteem ($r = .908$) and social support ($r = .891$) were found, indicating potential conceptual overlap [100]. Hopeful persons applied the coping strategies acceptance and fighting spirit more often than persons who were low on hope. They were also less likely to appraise their situation as a threat[124]. Relationships of hope with social reliance coping, with control appraisals, and challenge appraisals were statistically not significant [124].

3.3.6. Intellect, knowledge and competence

Ten studies addressed intelligence and competence of persons with SCI (Table 6). The evidence on the role of intellect in the adjustment process is weak. Intelligence of persons with SCI did not differ from a matched control group [125]. Verbal ability predicted disability acceptance at rehabilitation discharge in a longitudinal study.[126] Verbal ability and memory capacity were related with age, but generally not with lesion-related variables [80, 126]. A longitudinal study ($n = 17$) found high skin care knowledge predicting less pressure sore occurrence [69] but not skin care behavior. The authors of this study did not further elaborate on this counter-intuitive finding. Knowledge significantly

correlated with PC after 1 year follow-up and was enhanced in a multi-modal intervention program [75].

3.3.7. Personality and motivation

Personality is defined as characteristic patterns of thoughts, feelings and behaviors that make a person unique. Various personality attributes were assessed in 23 studies (Table 6). Overall, the evidence on the relation of personality characteristics with other variables is weak.

3.3.7.1. Major personality dimensions (the Big Five)

Agreeableness, extraversion, conscientiousness, openness to experience and neuroticism are considered the five major personality dimensions (Big Five). Together, they explained variance of depression and predicted disability acceptance and problem solving.[127].

Lower conscientiousness, but equal agreeableness and extraversion levels [128] were reported for people with SCI in comparison with normative [128] and healthy samples [129]. Extraverted persons reported less depression [127, 129], (phobic) anxiety [129], or other psychopathological symptoms [129] and rather participated in sports [130].

3.3.7.2. Social traits

Forgiving persons reported higher life-satisfaction and were more educated. Associations with health (behavior), and other socio-demographic and lesion-related variables were inconsistent [131]. High sociability was related with better adjustment, PIL and personality but not with locus of control or injury level [117]. Persons with SCI thought they would be more sociable and understanding without SCI [83], reported increased faith in others [85], and were as gregarious as a normative sample [128].

3.3.7.3. Motivational traits

Persons with SCI indicated that the injury negatively affected their enthusiasm [84], energy [83], decisiveness [83] and activity [84, 128], but increased their compassion [85]. Work motivation predicted employment status, was explained

by education and lesion level, but not related with age at injury, driving ability, locus of control and social support in a study using unstandardized measurement instruments [132]. People with high activity-orientation were more sociable and reported higher PIL [117]. Self-determination was not related to leisure boredom [133]. Leisure motivation did not increase in a sports program (n = 24) [134].

3.3.7.4. Other specific traits

People with SCI reported less flexibility since the injury [84]. They were more imaginative than a normative sample [128]. Hardiness was not related with locus of control or ethnicity, but explained variance of self-concept dependent on ethnicity [135].

3.3.8. Study quality

The evaluation of the studies' quality showed overall satisfying results. Case control, cohort and cross-sectional studies were rated with STROBE and attained a score of 15 on average (range from 9 to 21 points). Abstracts, introduction, variable definition, presentation and interpretation of study results were mostly satisfactory. However, only few studies considered potential sources of bias (9%), explained how the sample size was determined (4%) or reported additional analyses (9%).

5 randomized controlled trials were identified and rated with PEDro [67, 79, 88, 90, 92]. On average, studies achieved a score of 7.4 out of 11. Therapists and assessors were not blinded and only 2 studies [88, 90] performed concealed allocation and "intention to treat" analyses [55].

The results are fragmented, frequently not comparable across studies, and therefore require replication. The identified studies suffer from potential problems in measurement robustness, low sample sizes and problems of sample representativeness, for example by using convenience samples.

3.4. Discussion

Research on psychological resources in SCI appears to be broad, but fragmented, and consists mainly of cross-sectional studies conducted in English-speaking countries. This review shows that psychological resources can be compromised by SCI, and are associated with various adjustment outcomes, particularly mental health and well-being, but not with socio-demographic and lesion-related variables (Figure 4).

Self-efficacy, PC and self-esteem were frequently assessed. Fewer studies examined SOC, spirituality and purpose in life, optimism and hope, intelligence and personality. Relationships of psychological resources with coping, cognitive appraisals, activity and participation were rarely studied. Various psychological resources that were explicitly searched for in the literature were not identified in this review, although they might be important with regards to adjustment outcomes. For example, curiosity has a predictive role for the longevity of older adults [136] and correlates positively with life satisfaction [137] and well-being [138, 139]. In SCI, their role remains unclear.

The evidence for the relationship of self-efficacy and self-esteem with better mental health and higher well-being is fairly consistent in the SCI literature and in line with findings in other health conditions or the general population [140-145]. However, little is known about changes over time, and the direction of relationships or potential causal mechanisms have not been studied. In one longitudinal study, self-efficacy predicted quality of life post-injury, suggesting that strengthening self-efficacy might enhance life quality [62].

Evidence regarding associations of self-efficacy with other variables is to a large extent inconsistent or fragmented. Self-efficacy is not a homogeneous concept. Beside general self-efficacy, diverse specific constructs, like exercise self-efficacy, pain self-efficacy, social self-efficacy, etc. were assessed in single studies (Table 2), limiting the capacity to compare findings.

The review identified evidence for the relationship of SOC with SCI adjustment. SOC predicted mental health and was linked with coping and appraisal variables [124]. The findings confirm the theoretical role of SOC as a salutogenetic factor and are in line with research across various populations and health conditions connecting SOC with psychological well-being [146-149] or coping [eg. 150].

Spirituality and purpose in life in persons with SCI were only assessed in few studies. However, cross-sectional as well as longitudinal findings suggest associations with better mental health, higher quality of life and reduced mortality. These results are in line with research with populations with other health conditions such as HIV or Alzheimer disease or healthy populations [151-160]. Spirituality can be an important component in psychotherapy [161-163]. Beneficial effects of meaning making interventions on self-efficacy, optimism and self-esteem are reported [164].

The review of the literature suggests that people with SCI who are hopeful and optimistic are also more satisfied and less depressed [62, 95, 123, 124]. However, this relationship did not hold in longitudinal studies [62, 123, 124]. It could be hypothesized that hope and optimism support the affected people during rehabilitation while other resources might become more important after rehabilitation discharge. A second assumption could be that coping might mediate the long-term effect of optimism, since optimistic persons tend to use different coping strategies from pessimists [165]. Longitudinal multivariate studies are required to test these assumptions.

Only few intervention studies were identified that aimed at strengthening psychological resources. Testing psychological interventions and conducting randomized controlled trials in rehabilitation settings remain challenging [166]. Self-efficacy was the only psychological resource which was enhanced in multi-content intervention studies conducted with persons living in the community [74, 79, 88-90]. This is consistent with research in other chronic health conditions, where self-efficacy interventions that adopt various strategies such as the use different modes of learning or the involvement of significant others proved to be useful [167, 168]. Other studies might have failed to report similar results due to low sample sizes, underpowered analyses, or because the interventions were not appropriately targeted (e.g. for persons with low self-esteem).

Most studies on psychological resources have been conducted in the community but not in the clinical setting. It remains unclear whether psychological resources are more important in the short- or long-term. Thus, early detection and long-term follow-up in longitudinal studies would be valuable.

Overall, the associations found between psychological resources and other variables need to be interpreted with caution, because they might be the result of conceptual overlap. For example, certain spirituality questionnaires contain

items referring to emotional well-being, which would explain consistent correlations of spirituality with well-being [169]. Research of psychological resources could be enhanced by a clearer and more differentiated conceptualization and operationalization of the various factors.

This literature review is subject to several limitations. The search strategy as well as the selection of the literature depended on a rather narrow definition of the term "psychological resource" as concepts that are positively valued in themselves. In contrast, resources are often defined in a broader sense by their effect and include any means that serve to achieve a positively valued end. Therefore, the list of psychological resources, which guided this review could be debated and might not be fully exhaustive. Furthermore, social skills, locus of control and coping, which are psychological resources, have not been considered, because current reviews summarizing findings about these factors have been published in SCI [51, 170, 171]. It is important to note that coping was only mentioned if it was associated with one of the psychological resources which we have included. Consequently, the results of this review do not represent the whole picture of current knowledge on coping in SCI.

This review conveys a broad overview of the associations of psychological resources with factors and outcomes of the SCI adjustment process, but does not contain an in-depth analyses of specific aspects. Finally, this study focused only on quantitative research. A systematic review of qualitative studies could provide a complementary and more in-depth view for the understanding of psychological resources in persons with SCI.

A number of conclusions can be drawn from the findings of this review considering possible directions for future research. First, to achieve a less fragmented and more comprehensive understanding of the role of psychological resources and their complex interplay with other factors, appropriate data collection and analyses methods are required, i.e. the assessment of potential confounding variables and the use of multivariate analyses. Second, with regard to outcome variables, behavioral and social outcomes such as participation and integration were found to be rarely studied in relation to psychological resources in people with SCI. As participation and integration represent key outcomes of rehabilitation, further research would be warranted. Third, little is known about the changes in psychological resources across time following SCI and about the direction of effects in relation to other factors. However, longitudinal studies

hinted at self-efficacy, SOC, spirituality and purpose in life as potential variables affecting adjustment outcomes in the long term. Therefore, multivariate longitudinal research could provide further insights. Fourth, potentially useful psychological resources, such as curiosity [136, 137] or humour [172, eg. 173], are underrepresented in SCI research, and could be targets for further exploration. Finally, only few intervention studies were identified. However, studies suggest that strengthening self-efficacy, for example, could have a positive effect on quality of life [62]. The development and testing of targeted psychological resource-based interventions could benefit people with SCI and represent worthwhile research efforts.

This review emphasizes and provides insight into the role of psychological resources in the SCI adjustment process. It can inform health professionals who adopt a resource-oriented, person-centered approach in both the clinical and the community setting, and can add to the design of future SCI research.

3.5. Tables

Table 1. Characteristics of the 83 papers included in the systematic literature review.

	(n=83)	%
Country		
USA	44	52
Canada	10	12
Australia	7	8
United Kingdom	6	7
Taiwan	3	4
China	2	3
Norway	2	3
Sweden	2	3
Switzerland	1	1
Brazil	1	1
Finland	1	1
France	1	1
Greece	1	1
Italy	1	1
Portugal	1	1
South Korea	1	1
Study design		
Observational cross-sectional without control group	28	33.5
Observational cross-sectional with control group	28	33.5
Observational longitudinal without control group	11	13
Intervention randomized controlled trial	5	6
Intervention other	4	5
Intervention controlled clinical trial	4	5
Observational longitudinal with control group	3	4
Sample size - mean (range)	127 (9-1361)	
Age - mean (range)	39.8 (25-55.9)	
Not specified (n)	12	
Gender		
Male		70.4
Female		29.6
Not specified (n)	8	
Marital status		
Married (n)		43.2
not specified (n)	45	
Age at injury - mean (range)	28.1 (12.2-42.2)	
Not specified (n)	62	
Severity of injury		
Paraplegia		50.5
Tetraplegia		48.2
Complete injury		45.1
Incomplete injury		53.1
Traumatic injury		91.1
Non-traumatic injury		7.1
Time since injury in months - mean (range)	132 (1.5-300)	
Not specified (n)	29	
Setting		
Community based	53	64
Mixed	15	18
Inpatient	9	11
Outpatient	6	7

Table 2. Selected overarching groups of psychological resources, corresponding concepts and measurement instruments.

Overarching group of psychological resource (total number of studies), specific resource	Measurement instrument	Study reference
Self-efficacy (23)		
General self-efficacy (GSE)	The General Self-Efficacy Scale [174]	[57-60]
	General Self-Efficacy Scale [50]	[62, 70, 74]
	Perceived Benefit Scale [175]	[85]
Health-related self-efficacy (HSE)		
Disease-management self-efficacy	Self-Efficacy for Managing Chronic Disease [176]	[73]
Health-related self-efficacy	Self-rated Abilities for Health Practices Scale [177]	[92]
	The Perceived Health Competence Scale[178]	[62]
Pain self-efficacy	Pain Self-Efficacy Questionnaire [179]	[64, 91]
SCI self-efficacy	Moorong Self-Efficacy Scale [180]	[63-65, 91]
	The Beliefs Scale [181]	[66]
	Items constructed/adapted by authors	[81]
Self-efficacy for managing health condition	Stanford Self-efficacy for Managing Chronic Disease Scale[176]	[182]
	Items constructed/adapted by authors	[68]
Self-efficacy for Urinary Tract Infection prevention	Items constructed/adapted by authors	[67]
Self-efficacy related to other context		
Barrier Self-efficacy	Items constructed/adapted by authors	[79, 90]
Exercise Self-efficacy	SCI Exercise Self-Efficacy Scale [183]	[70]
	Items constructed/adapted by authors	[76]
Scheduling Self-efficacy	Items constructed/adapted by authors	[79, 90]
Self-Efficacy for active living	Self-Efficacy in Active Living [89]	[88, 89]
Self-Efficacy for task persistence	Items constructed/adapted by authors	[76]
Social Self-Efficacy	The Self-Efficacy Scale [174]	[59]
Control (17)		
Control (Personality)	Multi-dimensional Personality Questionnaire [184]	[185]
In-control	Self-Perception Scale [83]	[83]
Independent	Self-Perception Scale [83]	[83]

Overarching group of psychological resource (total number of studies), specific resource	Measurement instrument	Study reference
Mastery	Mastery Scale [186]	[86]
Pain control	Survey of Pain Attitudes [187]	[72]
	Survey of Pain Attitudes - short form [188]	[71]
PC	Personal Independence Profile [189]	[75, 82, 87]
	Perceived Stress Scale [190]	[61]
Perceived behavioural control	7-item measure of control-related constructs [191]	[78, 79]
Perceived exercise mastery	Self-Perception in Exercise Questionnaire [192]	[77, 193]
Perceived leisure control	Leisure Diagnostic Battery [194]	[195]
Personal control	Internal-External Locus of Control Scale [196]	[95]
Perceived behavioural control of skin checking	Items constructed/adapted by authors	[69]
Perceived behavioural control of pressure sore	Items constructed/adapted by authors	[69]
Self-esteem (20)		
Self-esteem	Rosenberg Self-esteem Scale [93]	[82, 86, 94-96, 98-100, 103, 104, 107, 197]
	Culture-Free Self-Esteem Inventory [198]	[83, 97, 102]
	Index of Self-Esteem [199]	[105]
Personal self-esteem	Culture-Free Self-Esteem Inventory [198]	[102]
Social self-esteem	Culture-Free Self-Esteem Inventory [198]	[102]
Sexual self-esteem	Sexuality Scale [200]	[95]
Confident	Self-Perception Scale [83]	[83]
Self-affirmation	No information in article	[88]
Self-reliance	Individualism-Collectivism scale [201]	[60]
Self-worth	Self-Perception Profile [202]	[106]
Sexual self-confidence	Spinal Cord Injury Women Questionnaire [101]	[101]
Sense of Coherence (5)	Sense of Coherence Scale [108]	[109-113]

Overarching group of psychological resource (total number of studies), specific resource	Measurement instrument	Study reference
Purpose in life (5)		
Purpose in life	Purpose in Life Scale [203]	[117, 118, 121]
Meaning making	Purpose in Life Scale [203]	[116]
Life regard (meaning)	Life regard Scale [204]	[95]
Spirituality (4)	Brief Multidimensional Measure of Religiousness/Spirituality	[120, 205]
	Intrinsic Spirituality Scale [206]	[115]
	Perceived Benefit Scale[175]	[85]
Hope (3)	Miller Hope Scale [207]	[100]
	Mental Adjustment to Cancer Scale [208]	[103, 104]
	State Hope Scale[209]	[124]
	The Hope Scale [210]	[123]
Optimism (4)	Life Orientation Test [211]	[62, 95]
	Adjective checklist [212]	[84]
	Self-Perception Scale [83]	[83]

Table 3. Associations of self-efficacy with concepts, type of analysis and corresponding coefficient. Only statistically significant and consistent results are shown.

Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Self-efficacy	*Mental Health*			
GSE, HSE	Anxiety	Corr	r = -.45 to -.515	[65, 74]
GSE, HSE, exercise SE	Depression	Corr	r = -.43 to -.611, +	[64-66, 70, 73, 74]
HSE, exercise SE	Depression	Regr	β = -.28 to -.35, +	[66, 70]
HSE [a]	Depression	Regr	β = -0.263	[73]
PC (pain control)	Mental health	Corr	r = .46 to .55	[71, 72]
	Mental health	Regr	β = 0.42	[72]
HSE	Helplessness	Corr	r = -.47	[66]
GSE, exercise SE	Alcohol consumption	Corr	+	[70]
Exercise SE [a]	Alcohol consumption	Regr	+	[70]
	Well-being and perceived health			
GSE, PC	Life satisfaction	Corr	r = .50 - .52,	[57, 61]
GSE, PC	Life satisfaction	Regr	β = .36 to .40, +	[57, 60, 61]
GSE, PC	Perceived health	Corr	r = -.216 to .45	[57, 58, 61]
HSE	Quality of life	Corr	r = .38 to .73	[62, 63]
	Quality of life	Regr	β = .265 to .312	[62]
	Quality of life	(M)ANOVA	F (8, 97) = 10.7, p < 0.001	[63]
GSE, social SE, PC	Well-being	Corr	r = .30 to .43, +	[57-59]
Social SE	Well-being	Regr	β = .21	[59]
	Socio-demographic and lesion-related variables			
HSE	Time since injury	Corr	r = .18 to.367	[68, 73]
HSE [a]	Time since injury	Regr	β = 0.205	[73]
PC [a]	Neurological impairment	Regr	+	[75]
Social SE	SCI vs general population	Diff	t= -2.34, p < .05	[59]
HSE	SCI vs Multiple Sclerosis	Diff	t = -2.46 (158), p < .05	[66]
SE	Change (increase after SCI)	Desc	26% of participants	[85]
PC	Change (before SCI vs after SCI)	Diff	+	[83]
Self-reliance	Change (before SCI vs after SCI)	Diff	+	[84]
PC (1 year post-injury) [a]	PC	Regr	β = .20	[75]
	Physical health			
HSE	Physical impairment	Corr	r = -.27	[66]
HSE	Secondary phys. conditions	Corr	r = -.52 to -.13	[67, 68]
		Path	β = -0.12	[68]
Exercise SE [a]	Breathing problems	Regr	+	[70]
	Pain			
Pain SE	SCI vs Pain-patients	Diff	t(45) = -5.29, p < 0.05	[64]

Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Pain control	Pain intensity	Corr	r = -.38	[72]
HSE	Pain intensity	Diff	OR = 2.7	[63]
Pain control	Pain interference	Corr	r = -.46 to -.53	[71, 72]
	Pain interference	Regr	β = -0.34	[72]
HSE [a]	Pain interference	Regr	ß = -.427	[73]
	Activity and Participation			
GSE	Recreation activity	Corr	r = .24	[57]
PC [a]	School activity	Regr	+	[75]
SE, exercise mastery [a]	Exercise activity	Regr	ß =.23 to .41, +	[76, 77]
HSE	Health behavior	Corr	r = .19	[68]
	Health behavior	Regr	β = 0.20	[68]
HSE	Health care use	Corr	r = -.16	[68]
	Health care use	Regr	β = -0.20	[68]
PC	Functional independence	Corr	r = .178	[61]
PC	Mobility restrictions	Corr	r = .175	[61]
GSE	Work activity	Corr	r = 0.35	[57]
PC [a]	Work activity	Regr	+	[75]
	Personal and environmental factors			
HSE	Cognitive distortions	Corr	r = -.37	[66]
PC	Knowledge	Corr	r = .34 to .38	[75]
GSE	Perceived manageability	Corr	r = .64 to .77	[74]
PC (1 year post-injury) [a]	PC	Regr	β = .20	[75]
Mastery	Self-esteem	Corr	r = .51	[86]
HSE	Denied health care services	Corr	r = -.02 to .10	[68]
HSE	Environmental adaptations	Corr	r = .18 to .22	[68]
PC [a]	Need of independent living service	Diff	+	[87]
	Intervention			
SE	Intervention (pre- vs post-intervention)	Diff	t(16) = 2.67, p < .05, Cohens d = .86; p < .05, Cohens d = 1.05; Z = 2.5, p < .05	[74, 88, 89]
	Intervention (pre- vs post-intervention)	(M)ANOVA	F(2, 84) = 6, p < .01, Cohens d = .60	[90]
	Intervention (treatment vs control)	ANCOVA	F(1, 32) = 4.76, p < .05, Cohens d = .52	[79]

GSE: General self-efficacy; HSE: Health-related self-efficacy; SE: Self-efficacy; PC: Perceived control; [a] Psychological resource is the dependent variable. Diff: Bivariate difference test; Corr: Bivariate correlation; Desc: Descriptive data analysis; Regr: Regression analysis; (M)ANOVA: (Multivariate) Analysis of variance; ANCOVA: Analysis of covariance; r = Correlation coefficient; β = Standardized beta-coefficient; Cohen's d: Measure of effect size; OR: Odds ratio; + : Result-coefficient(s) not described in the article.

Table 4. Associations of self-esteem and sense of coherence with concepts, type of analysis and corresponding coefficient. Only statistically significant and consistent results are shown.

Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Self-esteem				
Self-esteem	Life satisfaction	Corr	r = .43 to .65	[86, 94]
Self-esteem	Sexual adjustment	Regr	ß = .49	[95]
Sexual self-esteem	Sexual adjustment	Regr	ß = .58 - .68	[95]
Self-esteem	Depression	Corr	r = -.56 to -.74	[83, 86]
Self-esteem	Stress	Corr	r = -.49	[96]
	Stress	Path	ß = -.61	[96]
Self-esteem	Loneliness	Corr	r = -.45	[94]
Self-esteem	Mastery	Corr	r = .51	[86]
Self-esteem	Hope	Corr	r = .91	[100]
	Hope	Regr	ß = .53	[100]
Self-esteem	Coping (Emotion & Problem-focused)	Corr	r = .34 to .37	[96]
	Coping - Emotion-focused	Path	ß = .76	[96]
Self-esteem	Social integration	Corr	r = .54	[96]
Self-esteem	Activities physical	Regr	ß = .24 - 27	[99]
Confidence [a]	Change (before SCI vs after SCI)	Diff	+	[83]
Self-esteem [a]	Change (before SCI vs after SCI	Diff	t(60) = 4.58, p < .01	[102]
	1-year post-injury vs 2-year post-injury vs 5-year post-injury	(M)ANOVA	p < .01	[102]
Self-esteem	Received insurance benefits	Regr	ß = -.16 to -.38	[99]
Sense of coherence				
Sense of coherence	Psychosocial adjustment	Corr	r = .31 to 55,	[110]
	Psychosocial adjustment	(M)ANOVA	+	[109]
Sense of coherence	Mental health	Corr	r = .47 to 63	[110]
Sense of coherence	Quality of life	Corr	r = .554	[111]
Sense of coherence	Coping - Acceptance	Corr	r = .59 to .647	[110, 111]
Sense of coherence	Coping - Fighting spirit	Corr	r = .397	[111]
Sense of coherence	Coping - Social reliance	Corr	r = -.493	[111]
Sense of coherence	Appraisal - Loss	Corr	r = -.542	[111]
Sense of coherence	Appraisal - Threat	Corr	r = -.488	[111]
Sense of coherence	Appraisal - Challenge	Corr	r = .283	[111]
Sense of coherence [a]	Change (before SCI vs after SCI)	Desc	+	[110]
Sense of coherence [a]	SCI vs. general population	Diff	t(140) = 2.92, p < .05	[112]
Sense of coherence [a]	Intervention	Diff	+	[113]

[a] Psychological resource is the dependent variable. Diff: Bivariate difference test; Corr: Bivariate correlation; Desc: Descriptive data analysis; Regr: Regression analysis; (M)ANOVA: (Multivariate) Analysis of variance; ANCOVA: Analysis of covariance; Path: Pathanalysis; r = Corr coefficient; β = Standardized beta-coefficient; + : Result-coefficient(s) not described in the article.

Table 5. Associations of spirituality and hope with concepts, type of analysis and corresponding coefficient. Only statistically significant and consistent results are shown.

Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Spirituality & purpose in life				
Spirituality	Life satisfaction	Corr	r = .48 to .60	[115]
Meaning	Well-being	Regr	β = .58 to .73	[95, 116]
Spirituality	Mental health	Corr	r = -.27 to -.42	[115]
Meaning	Adjustment	Corr	r = .50	[117]
	Adjustment	Regr	+	[117]
Purpose in life	Mortality	Surv. Anal.	HR = .81	[118]
Spirituality	Change (increase after SCI)	Desc	43% of participants	[85]
	Change (rehabilitation admission vs rehabilitation discharge)	ANCOVA	Cohen's d = .10	[115]
Purpose in life	Locus of control	Corr	r = -.12 to .22	[117]
Purpose in life	Gender	(M)ANOVA	t(1,260) = 2.11, P < .05	[121]
Hope and optimism				
Hope	Functional independence	Corr	r = .33	[124]
Optimism	Well-being	Regr	β = .68	[95]
Hope [a]	Self-esteem	Corr	r = .91	[100]
Hope [a]	Social support	Corr	r = .89	[100]
Hope	Coping - Acceptance	Corr	r = .53	[124]
Hope	Coping - Fighting spirit	Corr	r = .69	[124]
Hope	Appraisal - Threat	Corr	r = -.65	[124]
Optimism [a]	Change (before SCI vs after SCI)	Diff	+	[83, 84]
Hope [a]	Education	Regr	β = .162	[100]
Hope [a]	Ethnicity	Diff	t = 2.18, p < .05	[100]
Hope	Time since mobilization	Corr	r = -.29	[124]
Hope [a]	Patient status	Diff	t = 2.47, p < .05	[100]

[a] Psychological resource is the dependent variable. Diff: Bivariate difference test; Corr: Bivariate correlation; Desc: Descriptive data analysis; Regr: Regression analysis; (M)ANOVA: (Multivariate) Analysis of variance; ANCOVA: Analysis of covariance; Surv. Anal.: Survival analysis; r = Correlation coefficient; β = Standardized Beta-coefficient; Cohen's d: Measure of effect size; HR: Hazard ratio; + : Result-coefficient(s) not described in the article.

Table 6. Associations of intellect and personality with concepts, type of analysis and corresponding coefficient. Only statistically significant and consistent results are shown.

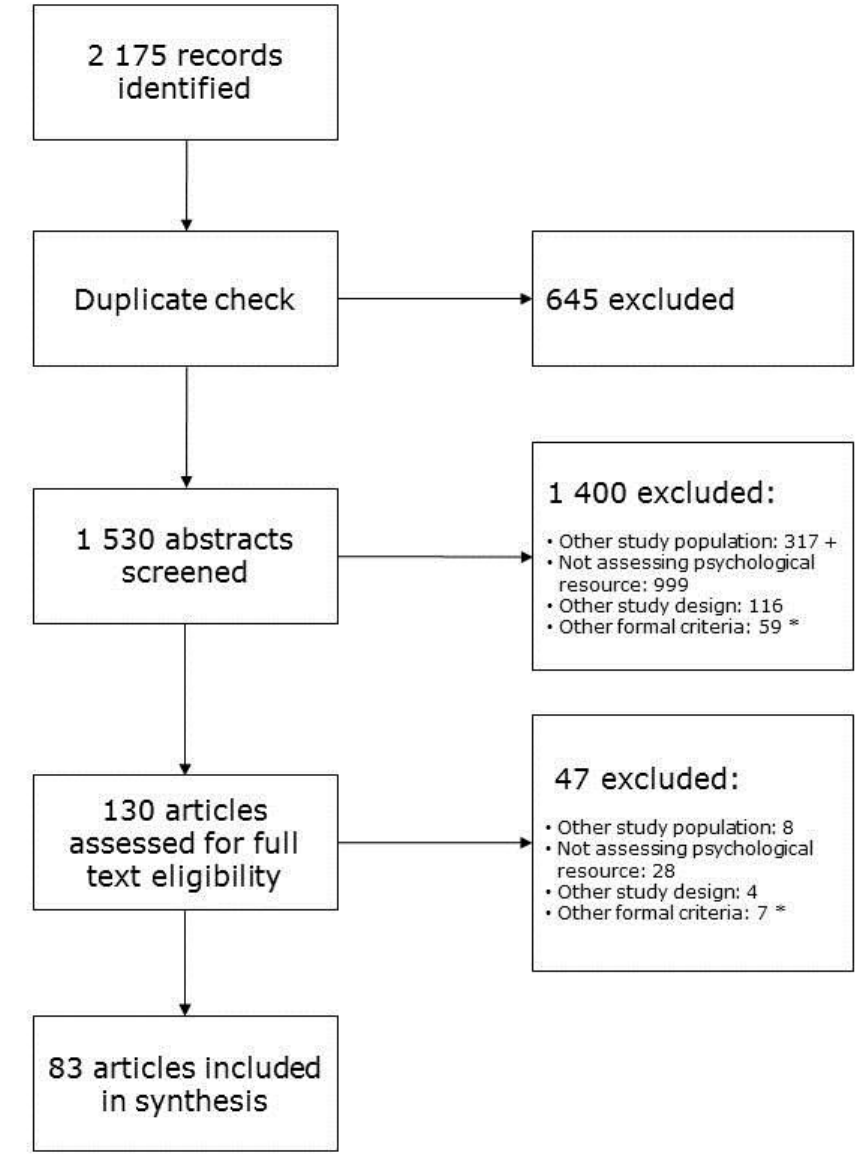
Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Intellect, knowledge, competence				
Verbal ability	Acceptance	Corr	r = .381	[126]
	Acceptance	Regr	β = .289	[126]
Verbal ability	Age	Corr	r = -.154	[126]
Verbal ability	Education	Corr	r = .206	[126]
Memory capacity	Age	Diff	t(44) = (2.12 to 3.93), p < .05	[80]
Knowledge	Pressure sore occurrence	Regr	β = .16	[69]
Knowledge	PC	Corr	r = .34 to .38	[75]
Knowledge [a]	Intervention (treatment group vs control group))	Diff	25.9% increase vs 12.5% increase, p < .05	[75]
Personality and motivation				
Big five				
Big five	Depression	Regr	+	[127]
Big five	Acceptance	Regr	+	[127]
Big five	Problem solving	Regr	+	[127]
Conscientiousness	SCI vs general population	Diff	t(104) = 8.40, p < .01	[128]
Extraversion	Depression	Corr	r = -.41 to -.37	[129]
Extraversion	Anxiety	Corr	r = -.32 to -.29	[129]
Extraversion	Sport participation	(M)ANOVA	+	[130]
Social traits				
Forgiveness	Life satisfaction	Corr	r = .258 to .277	[131]
Forgiveness	Education	Corr	r = .20 to .222	[131]
Sociability	Adjustment	Corr	r = .24	[117]
Sociability	Purpose in life	Corr	r = .45	[117]
Sociability	Level of injury	Corr	r = -.06	[117]
Sociability [a]	Change (before SCI vs after SCI)	Diff	+	[83]
Understanding [a]	Change (before SCI vs after SCI)	Diff	+	[83]
Faith in others [a]	Change (increase after SCI)	Desc	38% of participants	[85]
Motivational traits				
Enthusiasm [a]	Change (before SCI vs after SCI)	Diff	+	[84]
Energy [a]	Change (before SCI vs after SCI)	Diff	+	[83]
Decisiveness [a]	Change (before SCI vs after SCI)	Diff	+	[83]
Activity [a]	Change (before SCI vs after SCI)	Diff	+	[84]
Activity [a]	SCI vs general population	Diff	t(104) = 4.48, p < .01	[128]
Activity	Sociability	Corr	r = .27	[117]
Activity	Purpose in life	Corr	r = .34	[117]
Compassion [a]	Change (increase after SCI)	Desc	50% of participants	[85]
Work motivation	Employment status	Path	β = .28	[132]

Psychological resource	Associated variable	Type of analysis	Coefficient	Study reference
Work motivation [a]	Education	Path	β = .21	[132]
Work motivation [a]	Level of injury	Path	β = -.20	[132]
Self-determination	Leisure boredom	Regr.	+	[133]
Other specific Traits				
Flexibility	Change (before SCI vs after SCI)	Diff	+	[84]
Imagination	SCI vs. general population	Diff	t(104) = 3.55, p < .05	[128]

[a] Psychological resource is the dependent variable. Diff: Bivariate difference test; Corr: Bivariate correlation; Desc: Descriptive data analysis; Regr: Regression analysis; (M)ANOVA: (Multivariate) Analysis of variance; ANCOVA: Analysis of covariance; Path: Pathanalysis; r = Correlation coefficient; β = Standardized beta-coefficient; + : Result-coefficient(s) not described in the article.

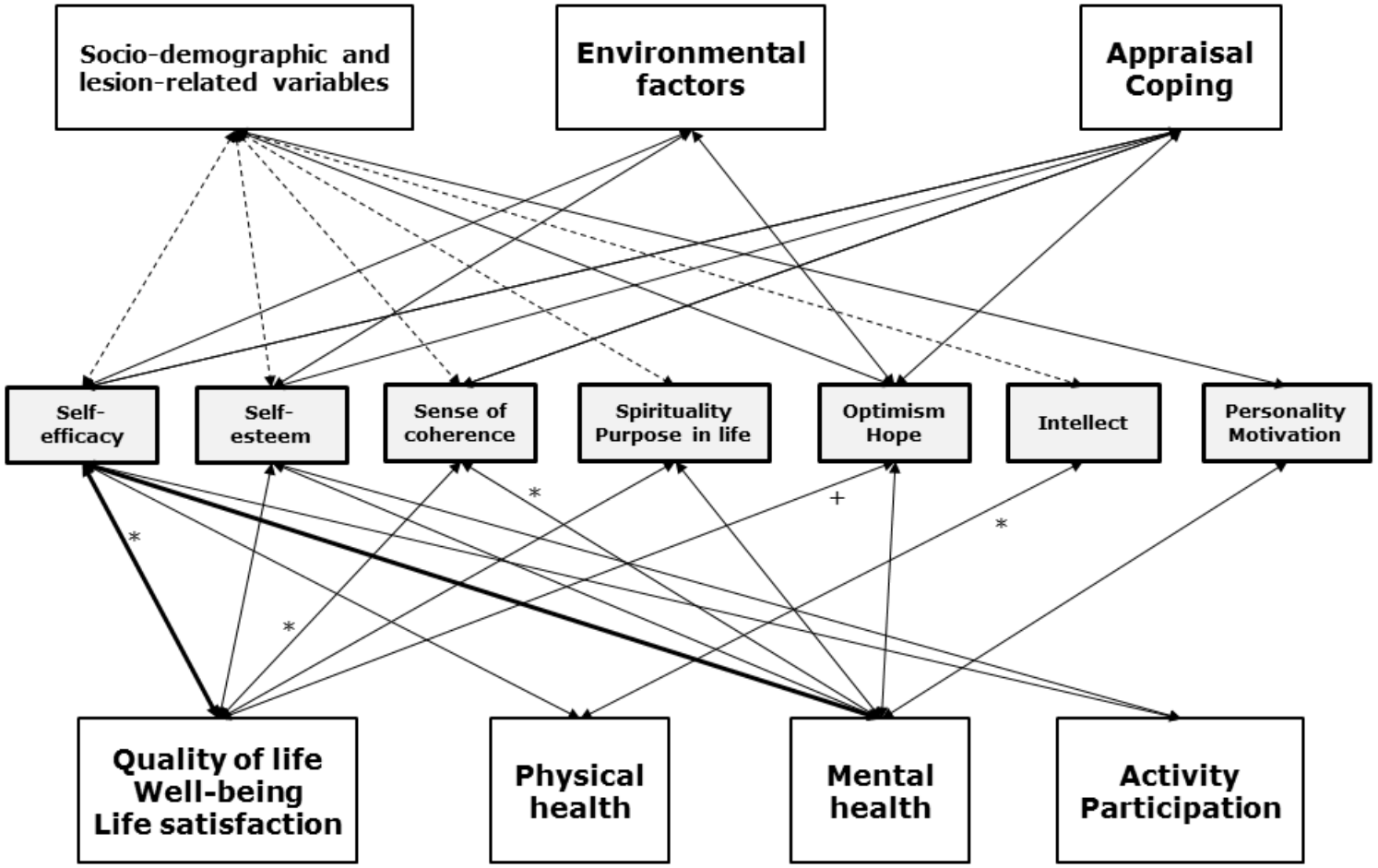
3.6. Figures

Figure 3. Flow diagram of the systematic literature review.



+ Numbers do not add up because several criteria can be applied to one article.
* Other formal criteria: No abstract, not in English, other publication type, published before 1990

Figure 4. Associations between psychological resources and factors and outcomes of the adjustment process in SCI.



Bold line: Association with strong evidence. Several studies conducted, consistent results shown.
Normal line: Modest/weak evidence. Single studies with associated variable conducted, or inconsistent results found.
Dotted line: No association. Several studies conducted, consistent results shown.
* : Internal resource is predictor of the variable in a longitudinal study.
+ : Internal resource is NOT a predictor of the variable in a longitudinal study.
Interrelations of the selected psychological resources are not depicted in this figure.

4. Stress, psychological resources and functioning in a person with spinal cord disease

Published article:

Peter, C., Rauch, A., Cieza, A., Geyh, S. (2012). Stress, internal resources and functioning in a person with spinal cord disease, NeuroRehabilitation 30, 119–130.

4.1. Objective and specific aims

The objective of this study is to demonstrate the targeted integration of psychological resources in the context of interdisciplinary clinical rehabilitation of spinal cord injury.

The specific aims are to illustrate (a) how decrements in functioning affected psychological resources and caused stress in a person with SCI, (b) how stressors and psychological resources were associated and addressed in the rehabilitation management to reduce stress, and (c) how ICF-based documentation tools facilitated the integration of stress-related issues in interdisciplinary rehabilitation management.

4.2. Patient history

The patient was a 23 years old electronics technician. He spent four months off work traveling in India and Thailand. Four weeks after his return, he came down with a fever along with headaches and angina. He was treated with antibiotics and immediately improved. One month later he felt a twitching and feeling of "pulling" at his left heel. Slowly, the odd feeling began to expand, travelled slowly up his calf finally leading to back pain. At this point the patient admitted himself to a nearby hospital.

On admission, extensive edemas around the thoracic spinal cord were found. Additionally, the patient had a blurry vision in his left eye due to inflammation (uveitis and retinitis). Although a high-dose treatment of steroids

was instantly implemented, the patient's condition deteriorated and progressed to complete paraplegia below Th-10. MRI scans and serology tests testing for viral and bacterial infections returned negative. It was assumed that the patient came down with a condition known as Behçet's Syndrome, a recurring, inflammatory disease that affects multiple body systems, in this case with symptoms comparable to SCI.

Over the following days, steroid therapy did show improvements: the edema lessened and some sensitivity restored. Three weeks later, the patient was transferred to an SCI unit for further rehabilitation and medical management. He still suffered from severe impairments in the body functional level such as complete impairment in movement, bladder and bowel functions. The patient felt "like a child again, not able to control the most basic things in life." Overall, at this point, prognosis was completely unclear.

In the first two months at the rehabilitation center the patient suffered several relapses; the inflammation reoccurred a number of times. However, the patient regained the ability to move his legs to some minimal extent, increased muscle power of the trunk and made great improvements in handling the wheelchair. In addition, he easily made new acquaintances. Although making these improvements, the patient felt extremely stressed, especially due to his insecure prognosis.

This case report refers to the time three months after the onset of the health condition. The health care team decided that the patient should undergo a comprehensive assessment which should serve as the basis for the future rehabilitation process. In the rehabilitation plan both the improved level of functioning and the severe perceived stress of the patient needed special consideration.

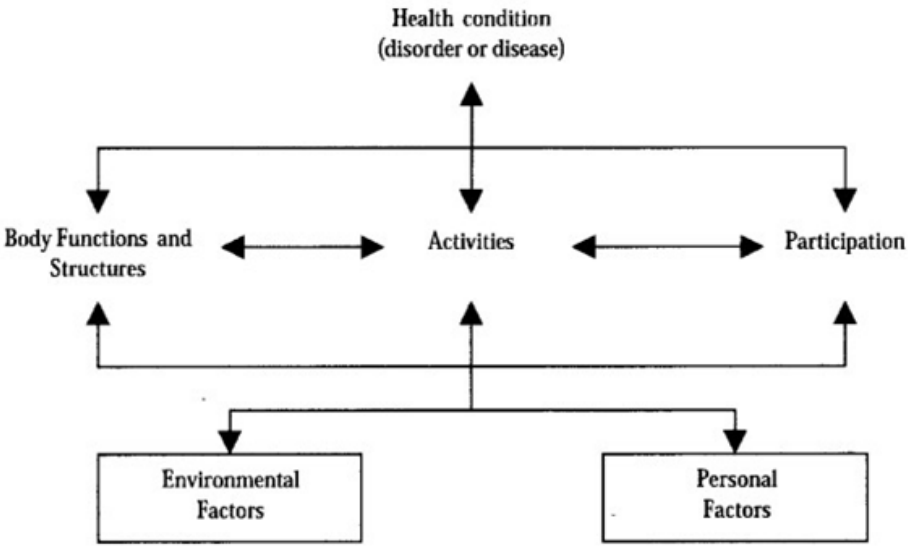
4.3. Case Study

4.3.1. Depicting disability after SCI – the International Classification of Functioning, Disability and Health (ICF)

The many-faceted nature of SCI calls for a multidimensional classification that is suitable to capture and comprehensibly describe disability following SCI. The

International Classification of Functioning, Disability and Health (ICF) provides a widely accepted integrative framework for the understanding and description of functioning and disability [53]. In this model, functioning is an umbrella term referring to three components (Figure 5): 1) body functions and structures, denoting physiological functions and anatomical parts, 2) activities, denoting task execution by the individual, and 3) participation, denoting involvement in life situations [53]. Those three components bi-directionally interact with the health condition, as well as with contextual environmental and personal factors in creating functioning and disability. Environmental contextual factors include physical, interpersonal and societal facilitators and barriers. Personal contextual factors according to their definition, include, among others, psychological resources [53, p.17].

Figure 5. The ICF-Model with the interaction of the components.



The classification encompasses lists of specific ICF categories within the different components [53]. The ICF categories are hierarchically structured: chapters (categories at the first level) consist of more specific second level categories, which are in turn made up of categories with increasing specificity at the third and fourth levels. Categories for the different components Body Functions, Body Structures, a joint list of Activities and Participations, and a list of Environmental Factors are provided. The following example illustrates the nested structure of the ICF categories:

b	Body Functions	
b1	Mental functions	(first/ chapter level)
b114	Orientation functions	(second level)
b1142	Orientation to person	(third level)
b11420	Orientation to self	(fourth level)
b11421	Orientation to others	(fourth level)

Overall, 30 chapters include 1424 categories at the second, third and fourth levels. The categories are accompanied by definitions, examples, inclusion, and exclusion criteria.

ICF Core Sets have been developed to support the application of the ICF. They are lists of ICF categories relevant for specific diseases or health-care contexts, describing problems in functioning and health of patients with that specific condition [213, 214]. For SCI, a ICF Core Set for the early post-acute situation [15] and a ICF Core Set for the long-term context were established [13].

To make use of the ICF in interdisciplinary rehabilitation, practical tools have been developed. These ICF tools use ICF Core Sets as a basis for documentation and individual rehabilitation management [213]. As such, ICF-based documentation tools allow for the assessment and accurate description of the level of functioning of a person, can be used to assign specific intervention strategies and to evaluate the progress of the level of functioning of the person with SCI [215].

4.3.2. Assessment

To comprehensively describe the level of functioning of the patient, the ICF Core Set for Spinal Cord Injury for the early post-acute context was applied [15]. All ICF categories contained in the Brief ICF Core Set and additional ICF categories from the Comprehensive ICF Core Set were selected to describe all aspects of functioning relevant to the actual situation. ICF-qualifiers were used as a rating scale from 0-4 (0 = no problem, 1 = mild problem, 2 = moderate problem, 3 = severe problem, 4 = complete problem) to report the extent of problems in the specific ICF categories [53]. For example, '*b134.1 Sleep function*' represents a mild problem.

In a first step, functioning from the patient's perspective was documented. The patient stated that since beginning steroid therapy, he had gained twenty kilograms. While he could sense his full bladder, he was neither able to control urination nor defecation. He felt it impossible to stand, get into a standing position or walk. Mobility limitations, recurring relapses of his health condition, his future working and living situation, together with his impairments in urination, defecation and maintenance functions were major sources of stress to him and negatively affected his psychological resource self-esteem. The patient stated that the strict daily structure of the rehabilitation unit was a significant stressor as well, leaving no room for privacy and reducing self-determination. This information was entered into the upper part of the ICF Assessment Sheet (see Figure 6).

In a next step, measures, tests and observations were conducted by the health professionals. They served as the basis for this evaluation and were summarized with the ICF Qualifiers. These results were entered into the lower part of the ICF Assessment Sheet (Figure 6) and in the column 'assessment' of the ICF Evaluation Display using ICF codes (Figures 7 and 8). The patient could not control urination and defecation functions and was dependent upon the usage of a urinary condom and showed restrictions in the regulation of defecation (due to incontinence). Hence, the patient's 'b525.4 defecation functions' and 'b620.4 urination functions' were rated as complete impairments with moderate limitations in 'd530.2 Toileting'. The patient could move his legs only to a very limited extent which made standing and walking impossible. Thus, *'b7303.4 Power of muscles in the lower half of the body', 'd450.4 Walking'* and *'d4154.4 Maintaining a standing position'* were rated as completely impaired or limited.

The patient could not keep his old employment; hence *'d850.4 Remunerative employment'* was rated as complete restriction. The patient also needed to move to a wheelchair-accessible apartment. The ICF category *'e155.3 Design, construction and building products and technology of buildings for private use'* was therefore seen as severe barrier. The health professionals observed that these limitations in functioning were major stressors, causing a considerable amount of stress. This stress was in turn seen as a potential risk factor with regards to the progress of his health condition. Self-esteem and self-

determination as psychological resources were reduced, but could potentially contribute to stress reduction if strengthened. The patient's openness and curiosity as well his musicality were seen as psychological resources that could reduce stress when integrated in the rehabilitation process (Figure 6).

Successful community reintegration was defined as the global rehabilitation goal, which also included regular monitoring of his disease and the actual prevention of secondary conditions. The service-program-goal, which was expected to be accomplished at the end of the rehabilitation program, was to achieve independence in daily living. Three cycle goals, namely reducing stress, improving mobility and improving toileting were defined. Intervention targets were identified from the list of ICF categories and set in relation to the rehabilitation goals. A goal value was defined by the team for each cycle goal and intervention target.

The relationship between goals and intervention targets was highlighted using connecting lines in the ICF Assessment Sheet (Figure 6). The associations between stressors, stress, stress handling and psychological resources are highlighted. Stress was caused by various stressors (in dashed panels). This process was influenced by psychological resources (dotted panel) and stress handling (double lined panel).The defined goals were also entered in the uppermost part of the ICF Evaluation Display (Figure 7).

4.3.3. Assignment and intervention

The ICF Intervention Table was used to document the intervention plan (Figure 9). With regards to cycle goal 1, i.e. reducing stress, several interventions were implemented.

Regular psychological counseling was assigned to handle stress and consolidate self-esteem. Also, other psychological resources were deliberately considered in order to handle and reduce perceived stress: To strengthen the patient's psychological resource musicality, a musical therapy was indicated. There the patient improved his guitar skills with another client. Rehabilitation steps and progress were repeatedly discussed with the patient to consolidate his self-determination. He was moved to a single room and hence given privacy to encourage and foster his self-determination and to remove a significant stressor.

Based on his curiosity and openness as psychological resources, several treatments were proposed to him to reduce stress. The patient chose to attend Feldenkrais-Therapy to relax from the tight rehabilitation schedule. It was assumed that by finding a new apartment and vocation and by improving the patient's toileting significant stressors would be removed.

To attain cycle goal 2, namely improved mobility, muscle power functions had to be improved by strengthening exercises guided by the physical therapist, as well as by archery and hippo therapy. In the later phase, Locomat training, water therapy, progressive gait training and walking training were incorporated to contribute to improvements in the mobility level.

Regarding cycle goal 3, toileting, both medical doctors and nurses instructed the patient in the urination and defecation management. To improve urination regulation, a stent was inserted into the urinary tract in a surgical invasion to decrease the pressure in the bladder. As stated above, it was assumed that improvements in toileting would also decrease the patient's stress.

4.3.4. Evaluation

A re-examination of his level of functioning was performed for all interventions shortly before discharge about five months after onset of disease. Again, measures, tests and observations were conducted and the results summarized utilizing the ICF qualifiers. The results were entered into the column 'Re-Assessment' of the ICF Evaluation Display (Figures 7 and 8). The rehabilitation course was evaluated by comparing the two functioning profiles from the assessment and reassessment. Overall, substantial improvements over the past weeks were observed. With regards to cycle goal 1, reducing stress, the interventions appeared to have contributed to an improvement, although the patient still experienced a considerable amount of stress. The patient experienced musical and Feldenkrais-therapy as well as having his own room as beneficial interventions which helped him to cope with his limitations in functioning. He also stated that he felt more respected because health professionals strengthened and supported his psychological resource self-determination. Also, the patient saw psychological counseling as valuable and important. Having found a wheelchair-accessible apartment represented the

extinction of a significant stressor which was a relief for the patient. However, both his vocational situation and the limitations in toileting had not improved and still remained major stressors. Latter still negatively affected his self-esteem.

Considerable improvements were observed with regards to cycle goal 2, mobility. The patient could stand and walk short distances without the help of any devices and was even able to walk a few hundred meters with the use of crutches. These improvements are depicted in the categories '*b7303.2 Power of muscles on lower half of the body*' and *'b7305.1 Power of muscles of the trunk', 'd4104.0 Standing'* and *'d4145.1 Maintaining a standing position'* and *'d450.2 Walking'* (Fig. 3). According to the patient, improvements in mobility were also an important factor in the stress reduction. Overall, cycle goal 1 and 2, namely stress reduction and an increase in mobility were at least partially achieved.

In contrast, cycle goal 3 was not achieved. Toileting aggravated due to attachment problems of the urinary condom which led to several leaking accidents. Therefore,*'b620.4 Urination functions'* remained totally impaired in terms of incontinence and *'d5300.3 Regulating urination'* was now rated as a severe restriction. In contrast, with the help of suppositories and by planning and sticking to a regular defecation schedule, the patient was able to improve *'d5301.1 Regulating defecation'*.

The overall evaluation of the program led to the decision to discharge the patient home. To address his remaining needs, he was assigned to an out-patient rehabilitation program.

4.4. Discussion

The experience of stress depends on the occurring stressors, the handling of stress, and the resources of a person [42]. Addressing psychological resources in persons with a multi-faceted, chronic health condition such as SCI already in the early rehabilitation process is of upmost importance to support and empower these persons and to achieve and maintain optimal functioning in the long-term [216, 217]. This case report illustrates how limitations in functioning affected psychological resources of a person with SCI and contributed to stress. The systematic consideration of stressors and psychological resources in a comprehensive rehabilitation management to reduce stress is described.

Furthermore, this case study illustrates how ICF-based documentation tools contributed to the emphasis of psychological resources and stressors in relation to stress within the interdisciplinary rehabilitation team.

Limitations in functioning after a SCI caused stress and affected psychological resources. The patient experienced high stress due to bladder and bowel impairments, limitations in mobility and related restrictions in employment and daily living. Self-esteem and self-determination as psychological resources were negatively affected. Self-esteem was severely challenged due to limitations in toileting following attachment problems of the urinal condom. Similarly, the patient perceived his self-determination as reduced due to the dependency upon the organization of the rehabilitation unit and the health professionals. These findings are in line with other SCI research [103, 104]. The psychological resources self-esteem and control are frequently perceived as being compromised by SCI [83, 84], although not every person with SCI experiences decreases in self-esteem [82, 86, 105]. Future research should answer the question, why certain persons appear less affected by SCI than others.

The negative impacts on the psychological resources caused additional stress for the patient, which supports the Conservation of Resources Theory [218, 219]. This theory posits that persons aim to "obtain, retain, and protect resources and that stress occurs when resources are threatened with loss or lost" [46, p. 312]. Therefore, the loss of resources is a central aspect of the stress experience [46]. Correspondingly, the patient experienced the decrease of an psychological resource, namely self-determination, as very stressful.

Psychological resources can not only be negatively affected by functioning limitations but can also work as facilitators when dealing with functioning limitations and stress. The patient's openness and curiosity were seen as psychological resources which could indirectly facilitate stress reduction. More specifically, it was assumed that the patient would be open for a variety of possible interventions such as Feldenkrais-Therapy [220, 221] to handle stress. Research shows several associations of curiosity with indicators of high well-being even though people with a higher degree of openness do not necessarily show better adjustment than others [222]. Curiosity is related to longevity of older adults [136], is positively associated with life satisfaction [137], and well-

being [138, 139]. Studies also showed associations of openness with positive adjustment outcomes in SCI [127]. Overall, the acknowledgement of the patient's psychological resources, such as curiosity and openness, seemed to be a promising attempt to reduce stress.

The integration of the patient's psychological resource musicality and the consequential attendance of music therapy appeared to have reduced stress. Research shows that people with high-musicality can benefit from and relax in musical treatment [223]. Music therapy aims at improving the emotional and/or physical health of people [224, 225], and is as effective as other psychotherapeutic interventions [226]. Stress reduction is one observed outcome, which corresponds with the experience of the patient. For him, musical therapy provided a possibility to learn new skills, release pent-up feelings, and relax from the tight rehabilitation schedule, which decreased his perceived stress.

Strengthening the patient's weakened self-determination appeared to be a relevant factor in the rehabilitation process. Self-determination is an important aspect of autonomy in SCI [227, 228]. Autonomy is achieved by freedom of action and freedom from interference by others (negative freedom), as well as by living the own life according to personal convictions and individual reasons and goals (positive freedom)[229]. The importance of these aspects is reflected in this case study. Active involvement in the decision taking and moving the patient to a single room increased his perceived self-determination and hence reduced stress.

Unfortunately, self-esteem did not improve by the end of the rehabilitation although the patient experienced psychological counseling as fruitful. Urination function interventions were not successful: Urination regulation remained a major stressor and impacted on the patient's self-esteem. So far, interventions on self-esteem in SCI have hardly been examined and did not show promising results [88, 107]. Persons with high self-esteem are more satisfied with life and report better mental health [83, 86, 94]. Therefore, future research should investigate how self-esteem could be strengthened when persons sustain a SCI and whether these enhancements would also have beneficial effects for the person's life satisfaction and health.

A comprehensive understanding of functioning and disability is the basis for rehabilitative interventions in an interdisciplinary setting. Interdisciplinary

rehabilitation involving psychological resources has proven to be more efficient than other rehabilitation models [216, 217]. The ICF-based documentation tools utilized in this case study did not only facilitate the depiction of the overall level of functioning, but also illustrated how functioning can affect stress and psychological resources (and vice versa).

The use of the ICF Core Setts for spinal cord injury helped health professionals to comprehensively describe the important aspects related to functioning [14, 15]. The ICF Assessment Sheet facilitated the depiction of both the patient's and professional's perspective of the functioning level and helped to identify and illustrate interactions between the components. Also, psychological resources as part of personal factors could be depicted and documented. Hypothesized associations between psychological resources, stressors, perceived stress and stress handling could be clearly illustrated, which represents the hypothetical relationship of contextual factors with the level of functioning in the underlying bio-psycho-social model [230]. Finally, ICF-categories could be related to the rehabilitation goals, which are the drivers of the rehabilitation program [231, 232].

The ICF Intervention Table was useful for the planning and assignment of precise interventions regarding specific ICF categories. The ICF Evaluation Display illustrated the results and represented the changes of the functioning level at the end of the rehab cycle [233]. This allows for an evaluation of the effectiveness of the chosen interventions, which "helps to assure effective and efficient use of limited resources" [234].

This study is subject to limitations. A rare condition in a single case is described. The term "resource" should only encompass those constructs that are resources for a wide range of persons across different situations [46]. Therefore, sound empirical research is needed to support the role of the discussed personal characteristics and to generalize the observations of this case to other SCI patients. Other important psychological or external resources such as social support were not discussed in this case study. The ICF tools were not part of the routine in the clinic but were used as part of a research project.

Overall, this case study aimed to highlight the role of psychological resources in the rehabilitation management of a person with SCI experiencing a considerable amount of stress. ICF-based documentation tools were applied to better depict the role of functioning, stress and psychological resources in

rehabilitation management. Although practitioners include and consider psychological resources in their daily work, the use of ICF-based documentation tools may highlight the role of psychological resources in the adjustment process and may contribute to a better and more comprehensive understanding of functioning in interdisciplinary teams.

4.5. Figures

Figure 6. ICF Assessment Sheet.

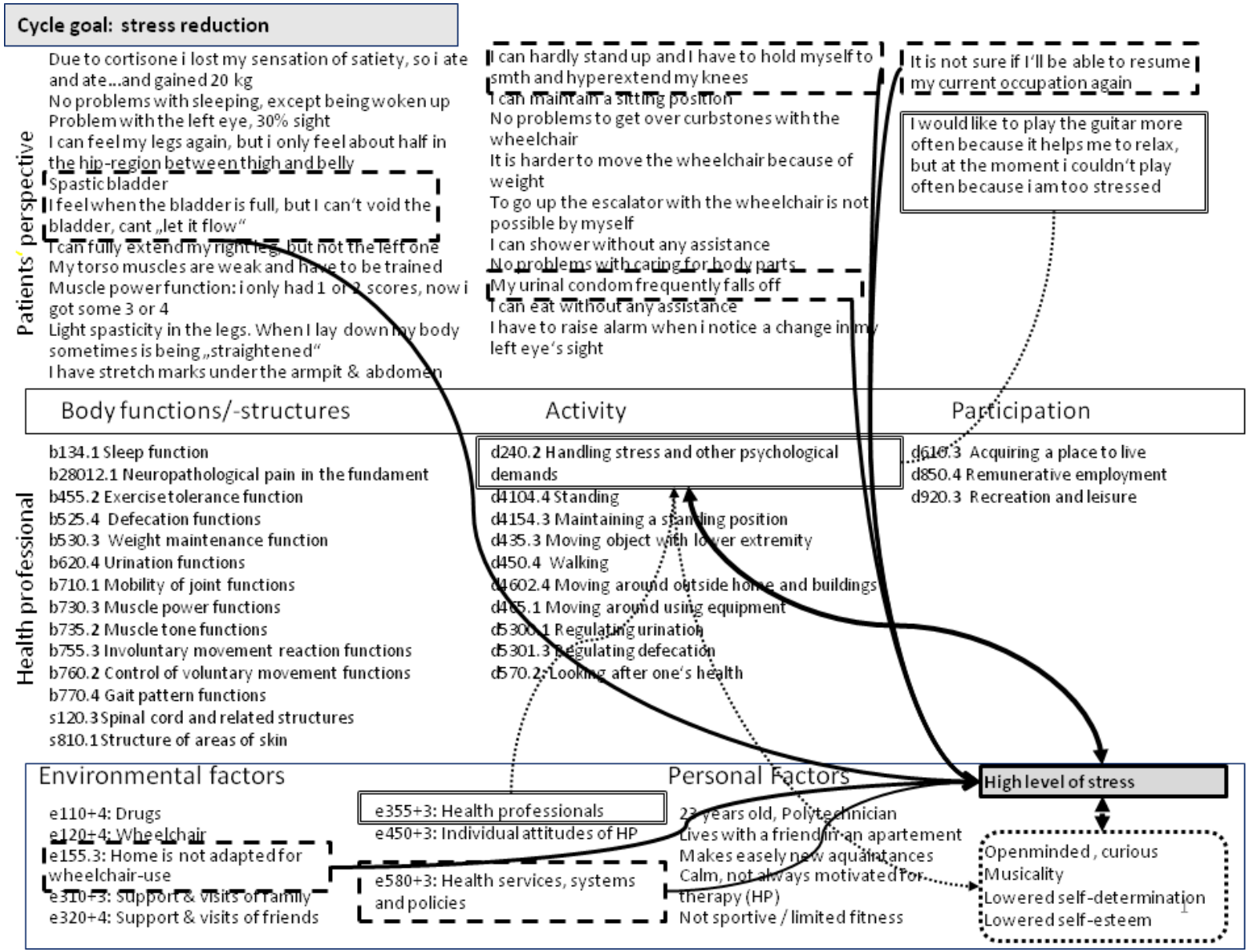


Figure 7. ICF Evaluation Display 'Body Functions and Structures' and 'Activity and Participation'.

Assessment				Re-Assessment	
Global Goal: Community reintegration, disease control and prevention of secondary conditions		1	Not evaluated yet		
Service-Program-Goal: Independence in daily living		1			
Cycle goal 1: Stress reduction		2			
Cycle goal 2: Improvement in Mobility		2			
Cycle goal 3: Improvement in toileting		1			
ICF Categories	**ICF Qualifier*** Problem 0 1 2 3 4	**Goal Relation**	**Goal value**	**ICF Qualifier*** Problem 0 1 2 3 4	**Goal achievement**
b210 Seeing functions		GG	1		-
b280 Pain		GG	1		✓
b455 Exercise tolerance functions		CG2	1		-
b525 Defecation functions		CG3	3		✓
b530 Weight maintenance functions		CG2, GG	2		-
b620 Urination functions		CG3	3		-
b6202 Urinary continence		CG3	3		-
b710 Mobility of joint functions		CG2	0		✓
b730 Muscle Power Functions		CG2	2		✓
b7303 Power of muscles lower body half		CG2	2		✓
b7305 Power of muscles of the trunk		CG2	1		✓
b735 Muscle Tone functions		CG2, CG3	1		✓
b755 Involuntary movement reaction functions		CG2	2		✓
b760 Control of voluntary movement functions		CG2	1		✓
b770 Gait pattern functions		CG2	3		✓
s120 Spinal cord and related structures		CG2	2		-
d240 Handling stress and other psychological demands		CG1	1		-
d410 Changing basic Body Position		CG2	1		✓
d4104 Standing		CG2	2		✓
d4154 Maintaining a standing position		CG2	1		✓
d450 Walking		CG2	3		✓
d4500 Walking short distances		CG2	3		✓
d4602 Moving around outside the home and other buildings		CG2	3		✓
d465 Moving around using equipment		CG2	0		✓
d530 Toileting		CG3	1		-
d5300 Regulating urination		CG3	1		-
d5301 Regulating defecation		CG3	1		✓
d570 Looking after one's health		GG	1		-
d610 Acquiring a place to live		GG	1		✓
d850 Remunerative employment		GG	1		-

Goal relation depicts the relation of intervention targets to goals. CG1: related to cycle goal 1; CG2: related to cycle goal 2, CG3: related to cycle goal 3; GG: related to global goal; * ICF Qualifier represents the extent of problems (0 = no problem to 4 = complete problem).

Figure 8. ICF Evaluation Display 'Environmental factors' and 'Personal factors'.

ICF Categories		Assessment											Re-Assessment									
		ICF Qualifier*									Goal relation	Goal value	ICF Qualifier*									Goal achieve-ment
		Facilitator					Barrier						Facilitator					Barrier				
		4+	3+	2+	1+	0	1	2	3	4			4+	3+	2+	1+	0	1	2	3	4	
e110	Products or substances for personal consumption										CG3	4+										✓
e115	Assistive products personal use in daily living										**GG**	**2+**										**-**
e120	Assistive products personal use in mobility										**CG2**	**4+**										✓
e155	Design, construction…of buildings for private use										GG	2+										
e310	Immediate family										GG	3+										✓
e580	Health services, systems and policies										GG	4+										✓
		Influence of personal factors											**Influence of personal factors**									
		positive					**neutral**				**negative**		**positive**					**neutral**				**negative**
pf	Experience of stress in relation to current situation										CG1	+										-
pf	Coping strategies										CG1	+										-
pf	Musicality										CG1	+										✓
pf	Self-determination										CG1	+										-
pf	Self-esteem										CG1	n										-
pf	Knowledge of disease and self-care										GG	+										-
pf	Openness, curiosity										CG1	+										✓

Goal relation depicts the relation of intervention targets to goals. CG1: related to cycle goal 1; CG2: related to cycle goal 2, CG3: related to cycle goal 3; GG: related to global goal; n= no change; * ICF Qualifier represents the extent of positive (+) or negative impact of environmental (e) and personal factors (pf).

Figure 9. ICF Intervention Table.

	Intervention target		Intervention	Phys	Nurse	PT	Spo	OT	Psych	SW	Others	First value	Goal value	Final value
Body functions and structures	b210	Seeing functions	Medication	X								2	1	2
			Regular checks ophthalmic clinic								Ophthalmologist			
	b280	Sensation of pain	Medication	X								1	1	1
	b455	Exercise tolerance functions	Endurance training with equipment, swimming			X						2	2	2
	b525	Defecation functions	Medication (suppository)	X								4	3	3
			Counseling in bowel management		X									
	b530	Weight maintenance functions	Fitness training				X					3	2	3
			Diet counseling								Dietician			
	b620	Urination functions	Urological examination, Cystometry	X								4	3	4
			Counseling in bladder management		X									
			Surgical intervention (Stent)	X										
	b730	Muscle power functions	Strength training			X						3	2	2
			Archery				X							
	b735	Muscle tone functions	Hippo therapy			X						2	1	1
	b755	Involuntary movement reaction	Body balance training			X						3	2	2
			Archery				X							
	b760	Control of voluntary movement functions	Active exercise training, Proprioceptive Neuromuscular Facilitation (PNF)			X						2	1	1
	b770	Gait pattern functions	Gait training (also in water), Locomat			X						4	3	1
	s120	Spinal cord and related structures	Medication	X							Rheumatologist	3	2	3
	s6102	Urinary bladder	Instruction bladder management	X	X							2	0	1
Activity and participation	d240	Handling stress and other psychological demands	Psychological counseling						X			3	1	2
	d4104	Standing	Muscle strength training				X					4	2	0
			Changing body positioning training		X	X								
	d4154	Maintaining a standing position	Muscle strength training				X					3	1	1
			Body balance training			X								

	Intervention target		Intervention	Phys	Nurse	PT	Spo	OT	Psych	SW	Others	First value	Goal value	Final value
	d450	Walking	Locomat Walking training Gait Training			X X	X					4	3	2
	d4602	Moving around outside the home and other buildings	Wheelchair technique training, City-training / Outdoor training			X		X				4	3	3
	d465	Moving around using equipment	Wheelchair technique training			X		X				1	1	0
	d5300	Regulating urination	Assistance and instruction for use of urinal condom & catheterization		X							1	1	3
	d5301	Regulating defecation	Assistance and instruction		X							3	1	1
	d570	Looking after one's health	Assistance and instruction	X	X	X		X	X		X	2	1	2
	d610	Acquiring a place to live	Assistance					X				3	1	0
	d850	Remunerative employment	Vocational counseling Art therapy								Voc. counselor Art therapist	4	1	4
Environmental factors	e110	Products or substances for personal consumption	Adaptation of medication	X								+3	+4	+4
	e115	Assistive devices	Abdominal belt	X	X							+1	+2	+1
	e120	Assistive products for personal mobility	Clarification, counseling & order of crutches and wheelchair			X		X				+3	+4	+4
	e155	Design, construction…of buildings for private use	Clarification					X						
	e310	Immediate family	Education and counseling	X								+2	+3	+3
	e580	Health services, systems and policies	Clarification and organization of payment	X						X		+4	+4	+4
Personal factors	pf	Experience of stress in relation to current situation	Psychological counseling Feldenkrais therapy Music therapy (playing guitar)						X X X		Music therapist	-	+	neutral
	pf	Coping strategies	Psychological counseling, Feldenkrais therapy						X X			neutral	+	neutral
	pf	Musicality	Music therapy (playing guitar)						X		Music therapist	+	+	+
	pf	Self-determination	Own room Discussion of rehab. progress	X X	X X							-	+	neutral
	pf	Self-esteem	Psychological counseling Toileting-related interventions	X					X			-	neutral	-
	pf	Knowledge of disease and self-care	Education	X	X	X						-	+	neutral

Phys: physician; PT: physiotherapist; Spo: sport therapist; OT: occupational therapist; Psych: psychologist; SW: social worker.

5. Rasch analysis of the General Self-Efficacy Scale (GSES) in spinal cord injury (SCI)

Article submitted (Journal of Health Psychology), manuscript version.

5.1. Objective and specific aims:

The objective of this study is to examine the psychometric properties of the General Self-Efficacy Scale (GSES) using Rasch analysis in a German-speaking sample with SCI living in Switzerland.

The specific aims are a) to test unidimensionality, b) to test the reliability, c) to test the structure of the response scale, d) to examine the targeting of the instrument and e) to check for item bias or differential item functioning (DIF) with regards to age, gender, education and level of injury.

5.2. Methods

5.2.1. Study design and participants

The psychometric evaluation of the GSES was conducted using cross-sectional data from a multi-centre study including people with SCI living in the community. Participants were recruited through three major SCI rehabilitation centers in Switzerland (University Clinic Balgrist, Paraplegic Centre, Zurich; Swiss Paraplegic Centre, REHAB Basel; Swiss Paraplegic Centre (SPZ), Nottwil). Data were collected by means of a self-report questionnaire sent to the eligible participants by postal mail. Design and study materials were approved by the ethical committees of the cantons Lucerne, Basle, and Zurich.

Persons with SCI were eligible when they were German-speaking, older than 18 years and discharged from first rehabilitation since at least half a year. Persons with a progressive neurological disorder, a neoplasm of the spine, or a concurrent neurological condition that affected mental functions were excluded. Every participant signed a consent form.

In the data collection the socio-demographic variables age, gender, education and marital status and lesion-related information such as level, completeness and etiology of injury on each patient were included. The German version of the General Self-Efficacy Scale (GSES) was used as an outcome measure [235].

5.2.2. The General Self-Efficacy Scale (GSES)

The General Self-Efficacy Scale consists of 10 items assessing a general belief in the own ability. For example, Item 4 is phrased "I am confident that I could deal efficiently with unexpected events" [50]. Items are assessed on a 4-point response scale with 1 = not at all true, and 4 = exactly true. The responses to all 10 items are summarized to form a total score, ranging from 10 to 40 points, where a higher score indicates higher self-efficacy. Overall, classical test-theoretical examinations of the psychometric criteria report satisfactory reliability and validity [236-238]. Cronbach's alpha in a study comparing the GSES scores of 25 countries were ranging from $.75 < \alpha < .91$ [236]. Also, correlations with depression or optimism provided evidence for validity [238].

5.2.3. Rasch analyses

Rasch analyses were conducted with RUMM2030 software [239]. Rasch analysis estimates person parameters, the item parameters, and the parameters of the thresholds of the response scale (e.g., a 4-point Likert-scale).

These parameters describe the position of the persons, items and thresholds on the continuum of the measured unidimensional latent trait, ie. low to high self-efficacy. Therefore, the parameters are directly comparable because they are placed on one continuum sharing a common metric (logit) scale. They are regarded as sufficiently describing the response pattern in an item-person encounter. The estimation of the parameters is, however, dependent on the sample size. The higher the sample size the more stable are the item calibrations [240]. For example, with a sample of 50 persons the estimated item difficulties are within one logit of their stable value with a 95% confidence, which is considered close enough for most practical purposes [241].

First, unidimensionality of the measurement instrument was studied. Unidimensionality is an important aspect of construct validity. It means that items contribute to the measurement of only one single attribute [242]. If data fit the Rasch model, the person estimates are interval scale level measures unbiased by the sample distribution, and the additivity of the score is ensured [243]. Unidimensionality can be checked by comparing the observed responses in a set of items with the expected values predicted by the Rasch model [242, 244-246]. The fit of each item is indicated by standardized residuals (z values) and Chi^2 test results. Z values exceeding +/- 2.5 were considered to indicate misfit to the Rasch model.

Reliability was examined with the person reliability index. It represents an analogous value to Cronbach's alpha and ranges between 0 and 1, where the value of 1 indicates perfect reproducibility of person placements [246]. The person reliability index is constructed using the measurement error and the observed variance associated with the person parameters to calculate the ratio of ''true'' variance to the observed variance [247].

The structure of the response scale was studied with reference to the ordering of the threshold parameters for each individual item's response scale. Thresholds are boundaries between response categories. The threshold parameters should reach increasing values, as they represent successive transition points along the response scale. Reversed thresholds indicate that the response scale does not work as intended [248]. In addition, the distribution of the responses across the response categories is examined. With fewer than 10 observations in a response category, the threshold parameters may be imprecise [248]. Graphical probability curves of every item were studied to examine the structure of the response scale.

The targeting of the GSES is studied. First, the respective distribution of the person, item and threshold parameters along the latent trait continuum was examined. Second, the percentage of persons with measures below the level of the lowest threshold, and of those with measures above the level of the highest threshold, were calculated. Third, the distance between the mean person location and the mean item location was analyzed. 95% confidence intervals around the means were calculated to further evaluate floor and ceiling effects [242]. Forth, person strata index indicating the number of identified distinct ability levels was calculated using the formula [(4G+1)/3] [246].

Differential item functioning (DIF), or item bias, was examined to check for the invariance of the item parameters across each of four person groups: gender (male vs female), age (young vs old), education (high vs low) and level of lesion (para- vs tetraplegia). DIF analyses allow the validity of items across different patient groups to be assessed. For example, it could be hypothesized that tetraplegic people experience higher limitations in daily activities and participation as a consequence of their injury which might also have an effect on their level of self-efficacy. Therefore, items need to be equally suitable and "behave" in the same expected way in both para- and tetraplegic people. Potential DIF is ascertained for each item by the comparison of the standardized residuals between the groups and across the person parameter continuum using a two-way analysis of variance (ANOVA). A significant main effect of the group (e.g., gender) or an interaction effect in the ANOVA results (e.g., gender x self-efficacy) is an indicator of item bias. Bonferroni-corrected type I error level was used to identify DIF, correcting for the multiple significance tests conducted [249, 250].

5.3. Results

A total of 102 persons with spinal cord injury from 3 rehabilitation centers participated in this study. One person did not fill in the questionnaires accurately, leading to a total number of 101 study participants. Socio-demographic and lesions-related data is presented in Table 7. Overall, persons with SCI attained a mean total score of 31.6 (SD = 6.92) in the GSES (Table 8).

Of the 101 respondents, 91 persons were included in the final Rasch analysis. One case was invalid, while 9 scores represented extreme cases. Of these 9 cases, 7 persons achieved the highest possible total score (= 40) and two persons the lowest possible total score (= 10). However, although not being part of the Rasch analysis, the extreme cases were considered when evaluating targeting of the GSES (see below). A conversion table containing the raw total scores of the GSES and the corresponding converted Rasch logit scores can be found in table 9.

The GSES showed an overall fit to the Rasch model, indicating unidimensionality (Table 8). The Chi^2 test was not significant. Likewise, the items fit to the Rasch model. Only Item 1 slightly exceeded the critical standardized residual level; however, the Chi^2 test for this item was not significant. The person reliability index had a value of 0.92 (0.97 with extreme cases included), which indicates high reliability.

The structure of the response scale was studied based on the ordering of the threshold parameters for each individual item's response scale. No reversed thresholds on any item were observed; the thresholds showed the expected pattern of increasing values. With regards to the number of observed responses per category, the first category representing the lowest level of self-efficacy ("not at all true") was selected by less than 10 persons in 8 out of 10 items (items 1, 2, 4, 5, 6, 7, 9, 10). All other categories of all items were selected by at least 10 persons.

The thresholds of every item were inspected by examination of the graphical probability curves. Overall, the four categories of all items functioned well. However, the graphical probability curve for item 1 (If someone opposes me) and item 2 (Manage to solve difficult problems) only worked when including the extreme cases. If excluding the two extreme cases with a very low self-

efficacy level, the first response category would have never been the most probable for both items (since no participant marked this response category).

The mean difference between the location of the thresholds was 3.98 logits (between threshold 1 and 2) and 4.82 logits (between threshold 2 and 3). This mean difference lies within the recommended range of 1.4 and 5 logits [251]. However, threshold distances of several items exceeded the suggested range (Table 8). The thresholds of the first two response categories (not at all true, hardly true) of all items were located on the lowest part of the continuum and thresholds of the third (moderately true) and forth response category (exactly true) on higher self-efficacy levels.

To specify targeting and to examine floor and ceiling effects, the distribution of the person and item parameters along the latent trait continuum was examined first. Item means were not located along the whole continuum, but appeared to be "clustered" in 2 groups (Figure 10).

Eight item means were located within 1 logit, two item means were located about 3 logits lower on the self-efficacy continuum. Out of the 101 participants, 67 persons (66.3%) were located higher than the highest mean item location (Item 8). Item thresholds were spread along the logit continuum. However, a cluster trend with threshold one lying between -4 to -2, threshold two around zero and threshold three around 4 to 5 on the logit scale was observed (Table 8). Second, the percentage of the persons below the level of the lowest threshold, and of those above the level of the highest threshold was calculated (all study participants included). Out of the original 101 scores, 2 persons (2 %) scored below the lowest threshold, while 17 persons (16.8%) scored higher than the highest threshold. Third, the distance between the mean person parameter and the mean item parameter was examined. The mean person parameter had a value of 2.24 logits [CI 1.70 - 2.78 logits]. The mean item parameter is 0 by definition, the confidence interval ranged from -.30 to .30. Forth, person strata was calculated. Five strata could be distinguished. Altogether, these results indicate a ceiling effect. The participant's self-efficacy was higher than captured by the items.

Overall, differential item functioning was not indicated. The analysis of variance of the residuals did not show any effects for age, gender, education and level of lesion. An significant age effect was discovered for item 7. However, the

deviation from the ICC was marginal and in the higher interval. A removal of the item is not indicated.

With the clustering of the mean difficulties and thresholds, the items might appear redundant. It can be argued that the GSES could be shortened. To examine this, we performed a post-hoc exploratory Rasch analysis including five items of the GSES selected to maximize spread across the logit continuum (items 1,4, 5, 7, 8), which resulted in a satisfactory reliability of 0.82.

5.4. Discussion

The current study was the first examination of the psychometric quality of the GSES applying a Rasch-based methodology. The GSES proved to be a unidimensional and reliable instrument in SCI. The response scale structure was ordered. All items worked consistently across gender, age, education and lesion levels. However, the results indicated that targeting of the GSES is problematic and the differentiation across self-efficacy levels could be enhanced.

First, the items were too easy and demonstrated a ceiling effect given the level of self-efficacy in the current sample of persons with SCI. This is consistent with the findings from a study, which examined the metric properties of the GSES in psychology students also using an item response theory approach [252].

Second, most items did not differ in their level of difficulty, i.e. all but two item mean difficulties laid close to each other within the range of one logit. Thus, the item mean difficulties did not constitute a linear continuum progressing from low to high self-efficacy, but were clustered around one point of the self-efficacy logit scale. This might be explained by the similarities of the semantic structure and almost synonymous phrasing of the items. The ceiling effect and the low variation in item mean difficulty might pose a threat to the content validity of the GSES, i.e. the extent to which the entire universe of the domain to be measured is represented.

In contrast, the thresholds, which specify the transition points between the response options (from "not at all true" to "hardly true", from "hardly true" to "moderately true" and from there to "exactly true"), and which together constitute the item mean difficulty, have been found to be considerably distributed across a range of 16 logits. However, the distances between the thresholds were large with a mean of 4.2 logits, which indicates that additional response options might be advantageous and could enhance the precision of measurement [251, 253]. For most items, the thresholds were also clustered, i.e. the third threshold laid consistently around the level of 4-5 on the logit scale, the second threshold around 0, the first around -2 to -4. More variation again would allow for a more fine-grained differentiation of the self-efficacy level.

Overall, while the items tended to cluster around one point on the continuum of the self-efficacy logit scale, the response options showed considerable spread. In terms of reliability, the findings indicate that the

summary score of the GSES is capable of discerning five person strata, which supports the usefulness of the measure despite of the problems in targeting.

Within CTT, reliability depends on the number of items while reliability is calculated independent of the number of items within probabilistic test theory and Rasch-analyses [254]. The exploratory Rasch analysis with five items of the GSES resulted in a satisfactory reliability. A shortened GSES-version could be of use in large surveys by reducing respondent burden and potentially increasing response rate. However, further studies are required to confirm if a reduced GSES would still provide measurements with robust psychometric quality.

Across the analyses, the items 1 and 2 appeared to behave distinctly from the others. Their item mean difficulty was lower and thus made up a second cluster of items. This is explained by the exceptionally low level of the first threshold, which in turn is a consequence of the fact, that in our sample the first response option "not at all true" was never selected for these items. This irregularity cannot be attributed to a difference in the content of the items, but it could be hypothesized that the ordering of the questions lead to a bias, as they were prominently positioned as the first two items of the questionnaire. This might have affected the response pattern. Rotation of the item order could be used to test this assumption.

The sample size of this study is rather small. This may be connected with less precise and robust estimates and less powerful fit analysis [240]. The standard errors (Table 8) and the confidence intervals of all items in our analyses were small, indicating robust parameters. However, ANOVA may have missed to detect DIF due to the small sample size or due to the sample imbalance (e.g. with regards to gender). The concurrent use of more than one approach was proposed to examine DIF in small samples [255]. Thus, further testing with larger samples applying other approaches are needed to confirm the findings of this study.

From the analyses several suggestions for potential improvement of the GSES can be derived. To enhance the coverage of the whole self-efficacy continuum, to avoid ceiling effects and clustering of the items, further items could be introduced, which are located at a lower or higher self-efficacy continuum level, items could be rephrased and restructured to counter the semantic similarities, e.g. reversed items could be added, and redundant items removed. Because of the large threshold distances, an adaptation of the

response format could be indicated, e.g. by introducing additional response categories.

Adaptation of the GSES might prove useful especially in clinical practice and rehabilitation. Enhancing self-efficacy can be an important aim in SCI rehabilitation as positive effects on health behavior and participation can be expected [79, 90]. Assessment instruments can be used, for example, to identify persons with low self-efficacy who are at risk for unfavorable outcomes and who could benefit from self-efficacy interventions. They can also be used to monitor progress and evaluate intervention success [256, 257].

This study is subject to several limitations. The representativity of the study sample can be questioned, because of the low response rate. However, responders and non-responders did not differ in age, level and completeness of injury, but non-responders were more frequently women (data not shown). A comparably small sample size was used in this study. In addition, the study examined only basic psychometric properties of the GSES, but could not attend to criteria such as sensitivity to change.

Overall, the GSES seems to be a psychometrically sound instrument. However, the analyses indicate that targeting could be improved. Future research should apply modern test theoretical approaches such as the Rasch methodology to complement traditional approaches and reevaluate and improve assessment. In the context of clinical practice as well as research, such reexaminations could benefit all users of the measurement instruments.

5.5. Tables

Table 7. Socio-demographic and lesion-related data of the study population (N = 101).

	n	%
Age (mean in years)	56.28	
Gender	101	
Male	76	75.2
Female	25	24.8
Marital status	99	
Single	19	19.2
Separated/	9	9.1
Widowed	6	6.1
Married / partnership	65	65.6
Education (mean in years)	13	
Occupational status	99	
Remunerative employment	46	46.5
No employment	9	9.1
Retired	34	34.3
Other (house wife, education, etc.)	10	10.1
Level of lesion	100	
Cervical	37	37.0
Thoracal	41	41.0
Lumbal	19	19.0
Sacral	3	3.0
Completeness and level of lesion	101	
Complete paraplegia	24	23.8
Complete tetraplegia	3	3.0
Incomplete paraplegia	38	37.6
Incomplete tetraplegia	36	35.6
AIS Score	93	
A	29	31.2
B	13	14
C	15	16.1
D	36	38.7
Time since injury (mean in months)	43.5	

Note. AIS Score: The ASIA Impairment Scale (AIS) categorizes motor and sensory impairment in individuals with SCI. A: complete spinal cord injury with no motor or sensory function in the sacral segments; B: incomplete spinal cord injury where sensory but not motor function is preserved below the neurological level; C: incomplete spinal cord injury where motor function is preserved below the neurological level and more than half of key muscles below the neurological level have a muscle grade of less than 3, which indicates active movement with full range of motion against gravity; D: incomplete spinal cord injury where motor function is preserved below the neurological level and at least half of the key muscles below the neurological level have a muscle grade of 3 or more [258].

Table 8. Raw scores and Rasch-based fit statistics, ordering of the response scale thresholds, and reliability.

Items	m (sd) (n=101)	δ (n=91)	SE	z	ChiSq	df	Prob	τ	r	Threshold 1	Threshold 2	Threshold 3
Overall	31.6 (6.92) *				15.5	20	0.75	4-steps scale	0.92			
Item 1 - If someone opposes me	3.25 (.73)	-2.810	0.242	2.575	2.979	2	0.23	ord		-10.41	-1.38	3.36
Item 2 - Manage to solve difficult problems	3.18 (.76)	-2.610	0.236	0.146	2.258	2	0.32	ord		-10.61	-0.74	3.53
Item 3 - Stick to aims	2.92 (.95)	1.018	0.198	-0.315	1.260	2	0.53	ord		-1.54	0.37	4.23
Item 4 - I am confident	2.94 (.79)	0.739	0.222	-0.014	2.375	2	0.31	ord		-2.67	-0.37	5.25
Item 5 - Handle unforeseen situations	3.05 (.88)	0.485	0.206	-0.332	1.390	2	0.50	ord		-2.17	-0.31	3.93
Item 6 - I can rely on coping abilities	3.02 (.86)	0.541	0.209	0.514	0.826	2	0.66	ord		-2.58	-0.60	4.27
Item 7 - Whatever comes my way	3.06 (.86)	0.333	0.212	-1.501	0.608	2	0.74	ord		-2.78	-0.23	4.01
Item 8 - Find several solutions	2.92 (.90)	1.088	0.204	-0.471	0.359	2	0.84	ord		-1.40	-0.25	4.90
Item 9 - If I am in trouble	2.94 (.75)	0.498	0.235	-2.196	3.243	2	0.20	ord		-3.94	-0.11	5.54
Item 10 - Invest the necessary effort	2.86 (.74)	0.718	0.237	0.118	0.206	2	0.90	ord		-4.08	0.36	5.88

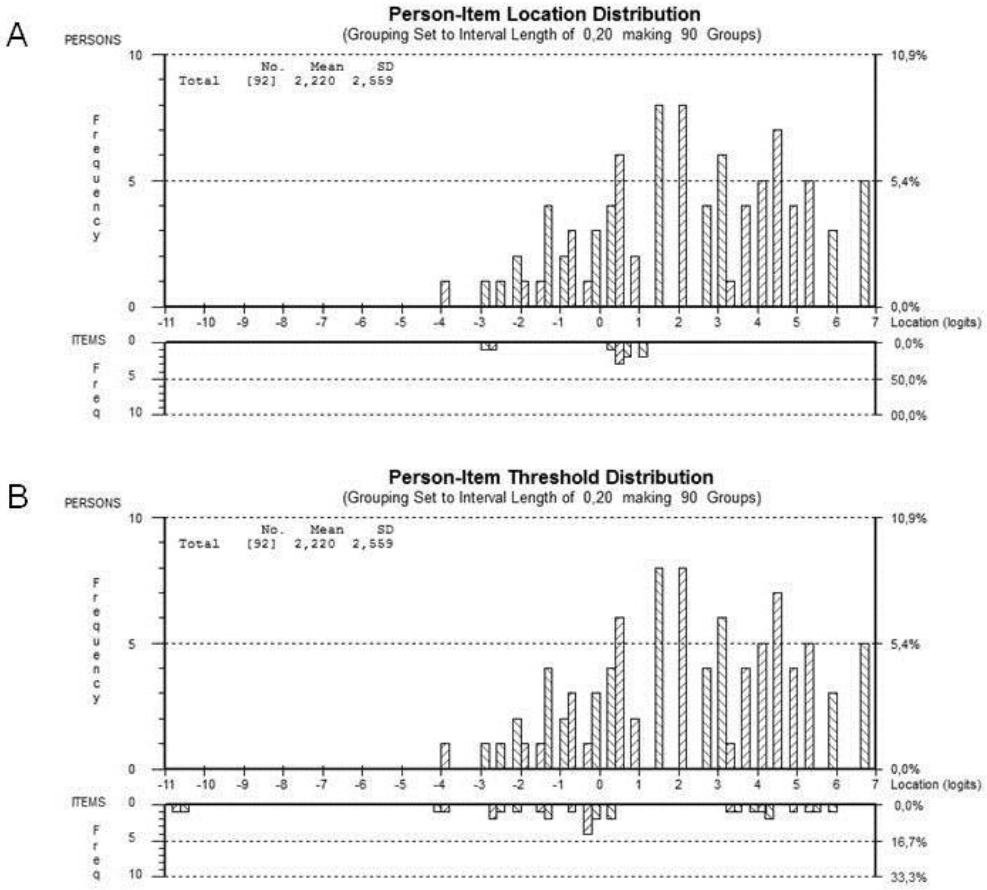
Note. m (sd): mean and standard deviation of raw scores; δ: Item location in logits (delta); SE: Standard error of item location; z: Standard normal distributed test value z; df: Degrees of freedom; Prob: Probability; τ: Ordering of the response scale thresholds (tau); ord: ordered response scale; r: Person reliability index; Threshold 1: location of threshold 1 on logit continuum; Threshold 2: location of threshold 2 on logit continuum; Threshold 3: location of threshold 3 on logit continuum; *Kolmogorov-Smirnov, alpha>.05 for GSES Total Score, indicating normal distribution.

Table 9. GSES Raw Score and Rasch Scale Score Conversion Table.

Total Score Raw	Rasch scale score (logit)
10	-6,06
11	-5,53
12	-4.98
13	-4.44
14	-3.90
15	-3.36
16	-2.88
17	-2.49
18	-2.13
19	-1.81
20	-1.51
21	-1.21
22	-0.94
23	-0.66
24	-0.38
25	-0.09
26	0.21
27	0.56
28	0.95
29	1.42
30	2.03
31	2.64
32	3.17
33	3.65
34	4.07
35	4.49
36	4.93
37	5.39
38	5.91
39	6.63
40	7.36

5.6. Figures

Figure 10. Person - Item Location Distribution (A) and Person - Item Threshold Distribution (B) (n = 92).



6. Modeling adjustment in spinal cord injury: the role of psychological resources

Manuscript, to be submitted in Archives of Physical Medicine and Rehabilitation

6.1. Objective and specific aims

The objective is to examine whether and, if so, how psychological resources interact with cognitive appraisals, coping and the adjustment outcomes quality of life, participation and depressive symptoms.

The specific aims are 1) to examine the associations between psychological resources and the adjustment outcomes participation, symptoms of depression, and quality of life, and 2) to examine whether appraisals and coping styles mediate the effects of psychological resources on adjustment outcomes.

With regards to aim 1, based on the results of study 1 it is hypothesized that stronger psychological resources are associated with higher quality of life, lower levels of depressive symptoms and more participation. Concerning aim 2, based on the SCIAM it is hypothesized that appraisals and coping styles mediate the potential impact of the psychological resources on all adjustment outcome variables.

6.2. Methods

6.2.1. Study design

A community-based cross-sectional survey has been conducted as a nested project within the nationwide Swiss Spinal Cord Injury Cohort study (SwiSCI). The ethical committees of the cantons Zurich, Lucerne, Basle and Wallis approved the study. The design of the larger SwiSCI cohort study is described in more detail elsewhere [259].

6.2.2. Participants, recruitment and procedures

SwiSCI includes persons with a traumatic or non-traumatic spinal cord injury, aged 16 years or older, and living in the community in Switzerland were eligible for the cohort study. Every participant signed an informed consent form. Persons with congenital conditions such as spina bifida, new SCI in the context of palliative care, or neurodegenerative disorders such as multiple sclerosis, were excluded from the cohort study. SwiSCI recruits participants through four specialized SCI rehabilitation centers, two SCI associations (Swiss Paraplegic Association SPV, parahelp), and the Swiss Accident Insurance (SUVA).

SwiSCI collects information on the full bandwidth of SCI aftermaths and potential determinants of SCI outcomes, including socio-demographic, lesion-related, functioning, and quality of life data. Data are collected by means of standardized self-report questionnaires sent out to the participants by postal mail (optional online survey). Persons received a written reminder 5 weeks after the sending and were contacted by phone if no answer was received yet.

One-third of the respondents of the larger SwiSCI study has been randomly assigned to receive the additional questionnaire for this nested study addressing psychosocial resources. The randomization took into account age, gender and lesion-related variables for bias reduction.

6.2.3. Measurement instruments

This study uses SwiSCI data about socio-demographic variables (gender, marital status, age, education), lesion-related variables (etiology of injury, time since injury, level and completeness of injury). In addition, the specific questionnaire for this nested study captured the adjustment outcomes depressive symptoms, participation, quality of life, the psychological resources self-efficacy and purpose in life, and the potential mediating variables coping styles and appraisals to answer the specific research questions.

The psychological resources assessed in this study have been selected based on the results of the systematic literature review (study 1). Of all psychological resources, self-efficacy was identified as most consistently associated with quality of life and depressive symptoms. Purpose in life was added as is has shown promising results but only has been scarcely examined in

SCI. Appraisals and coping styles were assessed because they represent central determinants of adjustment to SCI. Depressive symptoms, quality of life and participation were selected as adjustment outcomes because they are central rehabilitation goals and proxies of the lived experience of persons affected by SCI.

6.2.3.1. Outcome variables

6.2.3.1.1. *Depressive symptoms*

Depressive Symptoms were measured with the subscale of the Hospital Anxiety and Depression Scale (HADS), a widely used self-report measure for depression and anxiety developed for patients in non-psychiatric hospital clinics [260]. The HADS focuses on affective and cognitive rather than somatic aspects and can therefore be used in health conditions accompanied by symptoms similar to the symptoms of depression, such as loss of appetite, fatigue, or sleep disturbance. The 7 items of the depression subscale were used, responses are given on a 0 to 3 Likert scale. Higher scores indicate more severe symptoms of depression. Scores between 8 and 10 are considered as mild cases, 11-15 moderate cases, and 16 or above severe cases [260]. The HADS was found to be reliable and valid in assessing the symptom severity and caseness of depression in somatic, psychiatric, primary care and general populations [261, 262] and is frequently used in SCI [263]. Internal consistency in this study was good (Cronbach's alpha: .86).

6.2.3.1.2. Participation

Participation was measured with the Utrecht Scale for Evaluation of Rehabilitation-participation (USER-P) [264]. A subscale of the USER-P consisting of 11 5-point Likert scale items ranging from "not possible" to "without difficulty" was used. Participants are asked whether they are currently limited in their daily life. Items refer to leisure, work or mobility related activities such as going out or being visited by friends or family. Higher scores stand for higher participation. Satisfactory reliability and validity was reported for rehabilitation populations. Internal consistency in this study was good (Cronbach's alpha: .85).

6.2.3.1.3. Quality of life

Quality of life was measured with five selected items of the WHOQoL-BREF [265]. They cover overall life satisfaction as well as satisfaction in specific life domains, i.e. health, relationships, daily activities and living conditions. Higher scores indicate higher quality of life. Studies reported satisfactory psychometric properties, unidimensionality and cross-cultural validity [266-268]. Internal consistency in this study was good (Cronbach's alpha: .81).

6.2.3.2. Psychological resources

6.2.3.2.1. *Purpose in life*

Purpose in life or the extent to which a person has life goals was measured with the Purpose in Life Test-Short Form (PIL-SF) [269] which is based on the original 20-item Purpose in Life Scale [203]. The PIL-SF consists of four 7-point items which are all part of the original measurement instrument. Higher scores stand for a higher sense of life purpose. Good internal consistency with Cronbach's α between 0.84 and 0.86 and good validity was reported [269]. Internal consistency in this study was very good (Cronbach's alpha: .90).

6.2.3.2.2. *Self-efficacy*

General self-efficacy was measured with the General Self-Efficacy Scale [50]. It consists of ten 4-point Likert-type items and has been translated into numerous languages (www.ralfschwarzer.de). Higher scores denote higher self-efficacy levels. The GSE typically yields internal consistencies between alpha = .75 and .90 [236]. Convergent and discriminant validity is also given [238]. Overall, the GSE can be considered the standard generic instrument to assess general self-efficacy. The GSES has been frequently used in SCI research [62, 70, 74]. Internal consistency in this study was very good (Cronbach's alpha: .91).

6.2.3.3. Mediating variables

6.2.3.3.1. *Appraisals*

Cognitive appraisals were measured with the Appraisal of Life Events Scale (ALE). Using 16 adjectives person's responded how they appraised difficult life-events in the past 3 months on a 6-point scale. The adjectives refer to three dimensions: threat (six items, e.g. "terrifying"), challenge (six items, e.g.

"stimulating") and loss (four items, e.g. "pitiful"). Higher scores indicate higher appraisal levels. Good internal reliability and convergent validity have been reported [270, 271]. Internal consistency in this study was good (Cronbach's alpha for threat: .85; challenge: .86; loss .85).

6.2.3.3.2. *Coping styles*

How persons were dealing with stressful situations in their lives was assessed with the Brief COPE [272]. It consists of 28 items with a 4-step Likert scale ranging from 1 (not at all) to 4 (a lot) and encompasses 14 subscales (self-distraction, active coping, denial, substance use, use of emotional support, use of instrumental support, behavioral disengagement, venting, positive reframing, planning, humor, acceptance, religion, self-blame). Higher scores indicate more use of the specific coping style. Internal reliability estimates exceeding the minimally acceptable value of 0.50 per subscale have been reported [272], but were not observed in this study for a few subscales (Cronbach's alpha for self-distraction: .41; active coping: .74; denial: .65; substance use: .93;emotional support: .77; instrumental support: .81; behavioural disengagement: .41; venting: .56; pos. reframing: .61; planning: .47; humor: .71; acceptance: .66; religion: .90; self-blame: .52).

German, French, and Italian versions of all measurement instruments were used. Existing validated translations of the instruments were used as far as available. The items of all measurement instruments were checked for content consistency across languages in group sessions by bilingual persons and adaptations were made, if necessary, under consideration of cultural idiosyncrasies of all national languages.

6.2.4. Analyses

Socio-demographic and lesion-related variables were analysed descriptively to characterize the study population. Frequency and percentage rates were calculated. In addition, mean and standard deviations as descriptive statistics were calculated for all questionnaire variables.

To answer the specific research questions, structural equation modelling (SEM) is used. The assumptions of SEM analyses are checked prior to modelling, including checks 1) for missing data (rate and missingness at random by Little's Missing Completely At Random MCAR test), 2) for normality by examining the skewness and kurtosis indices (skewness (>2.0) and kurtosis (>7.0) are considered extreme), 3) for linearity of the data by examination of the scatterplots, 4) outliers (values >3 standard deviations are considered extreme), (5) for multi-collinearity examining Pearson correlation coefficients (r > 0.85 as cut-off score).

Pearson correlations were calculated to identify the associations between psychological resources, coping and appraisals and the outcome variables depressive symptoms, quality of life and participation. Correlation coefficients below 0.3 are considered weak, between 0.3 and 0.5 moderate and higher than 0.5 strong [273]. All preparatory statistical analysis are conducted using SPSS.

To answer the research questions three separate structural equation models are specified and tested, one model for each of the key outcome variables depressive symptoms, participation and quality of life. The models are specified based on the SCI adjustment model (SCIAM) by Middleton and Craig (2008) and taking into account the empirical literature as summarized in the systematic review of the literature in Study 1 within this doctoral thesis. The hypothesized model structure is shown in Figure 11.

Structural Equation Modeling (SEM) was conducted using Lisrel 8.80. SEM combines methods from regression analysis, path analysis, and factor analysis. Two types of variables are used: latent and observed (indicator) variables [274]. Latent variables are inferred from a set of observed variables and therefore not directly observable, for example, the latent variable "adjustment". Observed variables are the variables actually measured to represent the latent variable. Symptoms of depression or participation could be seen as indicator variables of the latent variable "adjustment".
SEM is commonly performed applying the 5 following steps: model specification, model identification, model estimation, model testing and model modification. Model specification involves the definition of a theoretical model of interest. In model identification it is tested whether a unique set of parameter estimates can

be found on the basis of the data. The model is then estimated and tested with regards to predefined model fit indicators. Finally, the initial model is modified if indicated by insufficient fit indicators. Models can be modified by adding or deleting variables and/or interrelations, e.g. examining the standardized residuals (> 2), the t-values of the parameters (> 2), the according Wald statistic, the modification index (MI) or the expected parameter change statistic (EPC). The more modifications of the initial model are conducted, the less confirmatory and the more exploratory becomes this process, the more data driven are the results of the final model, the less generalizable are the results. Cross-validation with another sample is then, if possible, indicated [275].

Model complexity and model estimation method are two factors contributing to the need for large samples when conducting SEM. The use of a too small sample size can affect the stability of the estimated model parameters. Previous guidelines regarding sample size considered 10-20 participants per observed variable or a size higher than 200 adequate [276].

A common strategy in SEM is to stepwise building up the measurement models, combining them into the structural models, adding complexity and comparing alternative models [274]. This procedure was followed by first examining the measurement model for the Brief COPE and testing the structural models in a second step. The measurement model of the Brief COPE was tested, as several studies reported different higher-order factor structures of the measure [277, e.g. 278]. The Kaiser-Meyer-Olkin (KMO) (.92) and Bartlett-Tests of sphericity ($p < .00$) indicated adequacy of the Brief COPE for factor analysis. Using the free software "R", a parallel exploratory factor analysis based on a Pearson correlation matrix using an oblique rotation was performed, as coping factors as assumed to correlate. Parallel factor analysis are seen as a precise method for determining the number of reliable components or factors [279, 280].

The analysis yielded 4 factors. "Emotional coping and support" contained the subscales emotional support (factor loading 0.83), instrumental support (0.69) and venting (0.63). The second factor "active coping" contained the subscales active coping (0.64), positive reframing (0.54) and planning (0.63). The third factor "avoidance" was based on the subscales self-distraction (0.5), denial (0.69), substance use (0.37), acceptance (-0.43) and self-blame (0.5). The fourth factor "humor" solely consisted of the subscale humor (0.66). Several

subscales had factor loadings higher than 0.3 on more than one factor: self-distraction (active coping (0.31) and avoidance (0.5)), substance use (avoidance 0.37 and humor 0.3), positive reframing (active coping 0.54 and humor 0.3) and acceptance (active coping 0.33 and avoidance -.43). Preliminary examinations of this 4-latent factor measurement model in Lisrel yielded very poor model fits. Consequently, the four factors were not depicted as latent variables, but summed up (total score per factor) and treated as observed variables in the analyses of the structural models.

Structural models were tested in a second step. An adjustment model based on the SCIAM was specified with each outcome variable (see Figure 11). Item parcelling was used for the adjustment outcome variables depressive symptoms, quality of life and participation. Item parcelling refers to a method in which item parcels are constructed instead of using a total sum score of a measure. For example, instead of using the total score of 10 items, the first and the second 5 items of the one-dimensional measure are parcelled. An advantage of this procedure is the creation of one latent variable consisting of the two parcels instead of using one observed variable consisting of the total score. With the use of latent variables measurement errors are incorporated in the model, which can reduce bias of the parameter estimates [281]. Item parcels can result in better model fits, but should not be used for multi-dimensional constructs [282].

Standardized path coefficients (β) correspond to effect-size estimates. Values greater than .50 indicate a large effect, values around .30 a mediocre effect and values around .10 a small effect.

Full Information Maximum Likelihood (FIML) was used for model estimation. It is based on the assumption that data is missing completely at random (MCAR) or at least at random (MAR). FIML can be used with missing data, without imputation of the missing values [283]. Maximum likelihood estimations can generally be used for total scores based on ordinal Likert-scaled items [284]. Maximum likelihood assumes multivariate normality, but shows robustness for even moderate violations of the normality assumption [276].

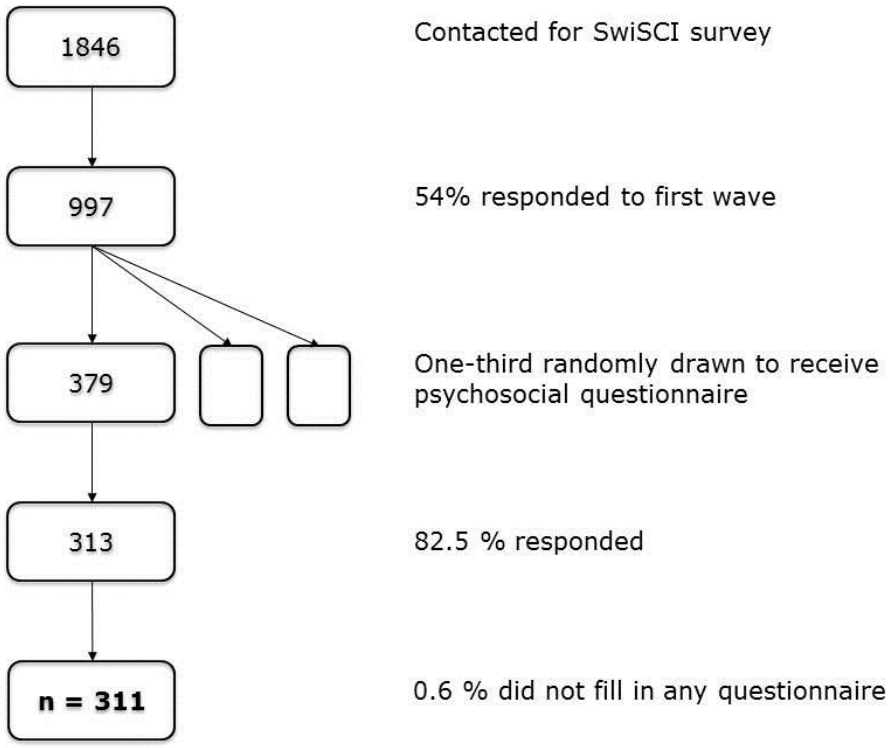
Model fit indices were used to evaluate how well the data fit with the theorized model. Chi-square test ($\chi 2$) and root-mean-square error of approximation (RMSEA) were used as global fit measures. A non-significant chi-square as well as a RMSEA close to <.06 or with a strict upper limit of 0.07 are

indicators of good model fit [285, 286]. Chi-square, however, is affected by the sample size: the higher the size of the sample, the higher the chance of a significant chi-square. A chi-square adjusted by its degrees of freedom ($\chi 2$ / df) not exceeding 2.5 is proposed as an indicator of good model fit [275, 287]. Comparative fit index (CFI) was used as a further model comparison index, with a value higher than 0.95 indicating good fit.

6.3. Results

Thirty-eight % of the respondents of the larger SwiSCI study were assigned to the present study. Return rate was 54 % for the first wave, and 82.5% for the present study. Overall, 313 persons participated in the present study. Two persons did not fill in any questionnaire and were discarded from further analysis, leading to a total sample of 311 (see Figure 12). This sample size can be considered adequate for SEM analyses considering the number of observed variables in the initial SEM-model.

Figure 12. Flow-chart of recruitment results.



Socio-demographic and lesion-related characteristics are depicted in Table 10. Participants were mainly male (71.7%), 53.5 years old, paraplegic (69,6%) and lived almost 20 years with their injury. Data was not attainable to compare between responders and non-responders. However, this aspect will be thoroughly discussed in a separate paper currently under preparation [288]. Table 11 lists the score range, mean, and the number of missings for each measured

construct. General self-efficacy had a mean score of 30.5 out of 40, purpose in life 21.6 out of 28. Adjustment outcomes participant's mean score in quality of life was 19 out of 25, participation 37.9 out of 55, and 4.2 out of 21 for symptoms of depression. Thirty-six participants (11.6%) reported mild levels of depression, 17 moderate levels (5.5%), and 4 participants severe depression levels (1.3%).

Checking for the further assumptions of SEM-analyses, a low incidence of missing data was found (2.6 %). Little's MCAR Test was significant ($p < .00$), indicating that the data is not missing completely at random. Data was treated as missing at random. The Brief COPE subscale "substance use" had a skewness value of 2.2, which is slightly above the cut-off score of 2 indicating non-normality. Data was not transformed as FIML shows robustness for even moderate violations of the normality assumption. Skewness and kurtosis values of all other variables were adequate. Scatterplots yielded linear patterns across all variables. Additional tests for curvilinearity were not significant. No variable had extreme outliers with values lying above or below 3 standard deviations. Recoding or removal was thus not necessary. Multicollinearity indicating conceptual redundancy was not observed.

The correlations between the assessed variables can be found in Table 12. The relationship between purpose in life and quality of life was the strongest positive correlation ($r = .58$), the association between quality of life and depressive symptoms was strongest negative correlation ($r = -.69$). Purpose in life correlated moderately with participation ($r = .24$), but strongly with symptoms of depression ($r = -.65$). General self-efficacy correlated positively with quality of life ($r = .51$) and participation ($r = .28$) and negatively with depressive symptoms ($r = -.59$).

The initial model with depressive symptoms as a latent outcome yielded a very poor model fit with $\chi^2 = 267.89$ ($p = 0,00$), $df = 27$, $\chi^2 / df = 9.92$,RMSEA = 0.170, CFI = .774. Under consideration of the size of the standard residuals and the theoretical and conceptual background of all variables the model was modified adding the following paths which did not correspond with the original theory, but improved the model fit: path from purpose in life to depressive

symptoms, from purpose in life to active coping, from loss to depressive symptoms, from self-efficacy to depressive symptoms, and from self-efficacy to humor. This modifications yielded a final model with a good model fit (χ^2 = 45.10, p = .00, df = 23, χ^2 / df < 2.5, RMSEA = .056, CFI = .988) explaining 67 % of variance of symptoms of depression (see Figure 13).

In the final model, self-efficacy had a significant small direct effect on depressive symptoms (β = -.16). The indirect impact via loss appraisals on depressive symptoms showed a partial mediation effect. Purpose in life was directly related to depressive symptoms with a path coefficient indicating a large effect (β = -.45). The effect of purpose in life on active coping was also large (β = .52). Loss appraisal was significantly related to symptoms of depression (β = .21), while other appraisals were not significantly related to this outcome. Avoidant coping was significantly associated with depressive symptoms with a path coefficient indicating a moderate effect (β = .38). Active coping, emotion and support as well as humor were not significantly associated with the level of depressive symptoms and did not act as mediating variables.

The initial model with quality of life as an latent outcome variable yielded a very poor model fit with χ^2 = 240.46 (p = 0,00), df = 27, χ^2 / df = 8.91, RMSEA = 0.160, CFI = .758. The model was modified by adding the following paths which did not correspond with the original theory, but improved the model fit: path from purpose in life to quality of life, from purpose in life to active coping, from loss to quality of life, and from self-efficacy to humor. This yielded a final model with a good model fit (χ^2 = 59.94, p = .00, df = 24, χ^2 / df < 2.5, RMSEA = .069, CFI = .959) explaining 70 % of variance of quality of life (see Figure 14).

In the final model, the influence of self-efficacy on quality of life was mediated by loss appraisals. Instead, the relationship between purpose in life on quality of life was direct with a large effect (β = .63). Purpose in life was also indirectly related to quality of life via the pathway challenge appraisal and humor, indicating a partial mediation effect. The effect of purpose in life on active coping was also large (β = .48).The path from loss appraisals to quality of life indicating a moderate effect (β = -.29) was the only direct association of appraisals with quality of life. Of the four coping strategies, only humor significantly influenced quality of life levels. The effect, however, was small (β = .16).

The initial model with participation as a latent adjustment outcome yielded a very poor model fit with χ^2 = 141.62 (p = 0,00), df = 27, χ^2 / df = 5.25, RMSEA = 0.117, (CFI = .877). Under consideration of the size of the standard residuals and the theoretical and conceptual background of all variables the model was modified adding the following paths which did not correspond with the original theory, but improved the model fit: path from purpose in life to active coping, from challenge to participation, and from self-efficacy to humor. This yielded a final model with an good model fit (χ^2 = 37.17, p = .04, df = 24, χ^2 / df < 2.5, RMSEA = .042, CFI = .986). A total of 19 % of variance of participation was explained (see Figure 15).

Self-efficacy had a moderate direct effect (β = .29) and a mediated effect via loss appraisal on participation, indicating a partial mediation effect. The association between purpose in life and participation was indirect: challenge appraisal and humor acted as mediators. However, purpose in life was directly related to active coping (β = .50). Of all hypothesized mediating variables only loss appraisal (β = -.16) and humor (β = .14) were significantly directly associated with participation, although effects were small. The other appraisal and coping variables had no effect on participation.

6.4. Discussion

Psychological resources are significant predictors of adjustment having a direct impact on depressive symptoms, quality of life, and participation. The first hypothesis was supported: persons with higher self-efficacy and more life purpose reported better mental health, higher quality of life and higher participation levels. The second hypothesis was not supported. Appraisals and coping styles only partly mediated the effect of psychological resources on the adjustment outcomes. Direct paths from the psychological resources to all outcome variables do not correspond with the theoretical underpinnings of the SCIAM and rather match with the SAC model, in which direct effects are, among others, proposed. While a high percentage of variance of quality of life and symptoms of depression was explained, the low explained variance of participation highlights that other non-psychological factors might play a more distinct role in explaining everyday difficulties reported by persons with SCI.

Purpose in life was the strongest predictor of good mental health and high quality of life in the present study with path coefficients indicating a large effect. This result corresponds with past research reporting positive associations between high PIL and high well-being [95, 116] and better adjustment in persons with SCI [117]. General self-efficacy, however, solely had a direct moderate effect on participation and depressive symptoms, but not on quality of life. These results are somewhat surprising as the associations between self-efficacy and both mental health and quality of life-related variables were the most consistent and strongest identified in study 1 of this doctoral thesis [e.g. 57, 58, 59, 66]. Some studies also identified self-efficacy as determinant of participation in multivariate analyses [e.g. 289].Thus, the stronger and direct impact of purpose in life as well as the mediated effects of self-efficacy were somehow unexpected, although the mediational mechanism corresponds with the SCIAM.

Although appraisals are seen as holding a central role in the adjustment mechanism, their effect on the adjustment outcomes in this study remains comparably weak. Only loss appraisal had a direct small to moderate effect on participation, depression symptoms and quality of life, and further mediated the effect of self-efficacy on mental health and quality of life.

The central role of loss appraisals is interesting, as it seems to contradict with other studies identifying several different appraisals as important adjustment determinants [e.g. 290]. A multi-center longitudinal European study with participants mainly from Great Britain and Germany conducted in the first weeks after SCI onset indicated that threat appraisal predicted more anxiety and lower quality of life measured 12 weeks after injury. Challenge appraisal was a significant predictor of lower depression levels at 12 weeks after injury [291]. In the follow-up study, however, it was loss appraisal measured 12 weeks after injury that was a significant predictor of higher anxiety and depression, as well as lower quality of life levels one year post-injury [292].

Overall, retention of loss perceptions seems to have negative long-term effects, as observed in the current study in persons with SCI living in the community. Perceiving a change or situation as loss means looking into the past with regrets, possibly with a limited capability to accept the current situation and wishing for change to the old state. A longitudinal study is needed to examine whether persons who cannot reduce their loss appraisals after SCI might be at higher risk for reduced quality of life or mental health over time. The fact that cognitive changes in loss appraisals regarding SCI do occur in the first few weeks after injury has previously been reported, the effect on the outcomes, however, has not been tested [291].

Results of the current study suggest that coping only plays a minor role when adjusting to stressful situations. Only significant paths from avoidance to depressive symptoms (moderate effect) and humor to quality of life and participation (small effect) were observed. The results reflect the somewhat inconclusive findings with regards to coping in SCI: Various different types of coping strategies were connected to different adjustment outcomes, but the identification of a clear pattern within these associations is lacking. For example, a literature review conducted by Galvin et al (2001) suggests that coping strategies such as wishful thinking and emotion-focused coping are connected to poorer adjustment, while the associations of self-blame with adjustment appears contradictory [20]. Problem-oriented coping styles, however, do not seem to lead to better outcomes per se: Emotion-focused coping was the most significant predictor of social integration in a South Korean sample [96].

Humor was the only coping strategy significantly affecting quality of life and participation. Research regarding humor in SCI is fairly neglected and mainly focuses on whether it is used as a coping strategy after SCI at all [e.g. 293]. The exposure to humorous video presentations was examined in a pilot study; however, due to the small sample size (n = 8) no clear conclusion could be drawn with regards to the effectiveness of the intervention [294]. The beneficial impact of humor observed in the current study could be connected with the positive effect of laughter, which, for example, has a role in stress hormone, pain or blood pressure reduction [295]. Humor is rather used in social interactions than alone, which might explain, why it is not only connected to higher life quality, but also with more participation.

The SCIAM and several of its domains were represented in the current study by inclusion of resources, appraisals, coping styles and outcomes. Two aspects, however, need closer attention. First, study participants were not specifically inquired how they appraise and cope with SCI because pre-tests indicated that persons living with SCI in the community for several years do not necessarily perceive their injury as a stress-causing aspect of their life anymore. Thus, more general tendencies (styles) of appraising and coping with stressful situations were asked. The models presented here illustrate how persons with SCI typically adjusted to past stressful situations, and not necessarily how they actually coped with their injury. Longitudinal data starting in the early-acute phase focusing on SCI-related cognitions and coping behaviours is needed to account for this issue.

Second, the SCIAM, as the underlying stress-coping model, can be criticized for the poor representation of the stress-causing situation [296]. SCI, with its physical impairments, consequential limitations in activities and participation encompasses many stressors. The Common Sense Model enumerates several important characteristics of the situation, such as the time line or duration (acute, cyclic, chronic), the causes (genetic, infection, food poisoning, etc), consequences (fatal, painful, etc.), or its controllability (susceptible to medical treatment). It could be used as a reference for the identification of distinct SCI-related stressors. Coping behavior, in these very specific and current stressor predictions, might have higher significance than suggested in the present study. Moreover, SCI coping research might yield a clearer picture if the applied coping strategies were connected to the distinct SCI-related stressors.

The research question guided the direction of the paths in the SEM models: Quality of life or depressive symptoms were treated as outcomes. However, same as they are being influenced by purpose in life or self-efficacy, they could also in turn influence the level of these resources, especially considering the cross-sectional nature of this study.

For instance, research suggests that the causal relation with regards to purpose in life and symptoms of depression is not clear and indicates reciprocity. Findings of a large longitudinal cohort study with the general population show that people with low levels of various well-being dimensions such as low purpose in life were at a higher risk of depression 10 years after first assessment, even after inclusions of various covariates in the analysis [297]. A longitudinal study with elderly people indicated that strong purpose in life does not prevent very old people from developing depression. However, being depressed at baseline and living with depression over five years is associated with a loss of purpose in life [298].

Low purpose in life and self-efficacy could also be interpreted as symptoms of depression, rather than as distinct variables with a direct negative impact on the depression level. The International Classification of Diseases (ICD-10) enumerates low self-confidence and negative thinking with regards to the future as symptoms of depression, which are conceptually similar to low self-efficacy or purpose in life [299]. Research in SCI has so far mainly examined the effect of self-efficacy on depression (see study 1). One cross-sectional study, however, identified depression as predictor of self-efficacy, supporting the hypothesis stated above [73].

The study results have implications for interventions, indicating that strengthening purpose in life, self-efficacy and cognitive appraisals could be a promising way to increase well-being, mental health and participation. Interventions targeting purpose in life in persons with SCI were not identified in study 1 of the current doctoral thesis, but generally different intervention techniques such as psychosocial counselling [300] or purposeful reminiscences including meeting past friends, visiting previous home sites, or reviews of personal documents of the past are applied [301]. Clear evidence, however, with regards to the intervention effects is frequently lacking.

Successful improvements in self-efficacy in persons with SCI were achieved with an active/independent living program [88, 89], physical activity or sports programs [74, 79, 90], or a wellness workshop intervention [91]. Cognitive appraisals are frequently tackled with cognitive behavioural interventions. For example, a Coping Effectiveness Training (CET) Programme incorporating cognitive behavioural therapy techniques yielded to changes in participants' negative appraisals of the consequences of SCI [302].

Interventions could be implemented in the clinical rehabilitation setting, as positive long-term effects can be expected. Group therapeutic interventions might have additional beneficial effects by facilitating exchange with others, learning from others or developing a sense of group feeling.

Structural equation modelling is a suitable method for both model confirmation (confirmatory approach) and model creation (exploratory approach). One main advantage is the use of latent variables and the inclusion of measurement errors in the structural equations. SEM, however, can also be used for model comparison. Various adjustment models to SCI or general chronic health conditions could be examined, model fits compared, and therefore models supported, rejected or even adapted. An ideal approach with regards to the depiction of the adjustment process using SEM could be: 1) theoretically building up or taking into account several adjustment models, 2) longitudinal assessment starting in the early-acute rehabilitation phase of the most important variables representing each model domain including a distinct account of the stress-causing situation and considering adequate sample size, 3) testing, comparison and (potentially) adaptation of models, and 4) cross-validation with another sample to support generalizability. Depending on the underlying research question, models can be created in a very broad sense, ideally using latent variables, or in a more granular sense, by closely examining the interaction of specific concepts.

This study is subject to several limitations. First, the study is of cross-sectional nature. Therefore, although the structural models indicate paths from one variable to the other, causality cannot be inferred. Second, study results represent a self-selected Swiss sample of persons with SCI living with their injury for 20 years on average and are thus not generalizable to the entire SCI

population. Third, a responder non-responder comparison could not be made because data was not attainable. However, this aspect will be discussed in a separate paper [288]. Fourth, the study is rather exploratory in nature, although a preliminary defined model was tested. Modified models are, at least to some extent, data-driven and cannot be generalized. The final model should therefore be cross-validated. Fifth, the chosen concepts and measures do not comprehensively cover the full bandwidth of psychological resources or appraisals. Also, environmental and biological factors were not included in the models of the present study. However, especially considering the low explained variance in participation, they might play an important role when adjusting to SCI. Finally, this study fully relied on self-report measures. Objective indicators of outcomes could be used complementarily.

The strength of the current study lies in the implementation of the theoretical background with regards to adjustment to SCI by incorporating the most central model domains in one study. It enabled the close examination of the proposed adjustment mechanism. Further, the simultaneous assessment of self-efficacy and purpose in life shed light to the significance of these resources, with regards to each other, but also with regards to appraisal or coping mechanism. Longitudinal data integrating a broad range of variables and specifically focusing on how newly injured persons with SCI adjust to their health condition is needed to support the findings of the current study. It is by the provision of clear evidence that interventions should be developed to support persons who are confronted with the many-faceted nature of SCI.

6.5. Tables

Table 10. Descriptive characteristics of study participants.

	Participants n = 311 (%)
Gender	
Male	223 (71.7)
Female	88 (28.3)
Missings	0
Marital status	
Single (never married)	106 (34.1)
Married	152 (48.9)
Widowed	38 (12.2)
Divorced	12 (3.9)
Registered Partnership	2 (0.6)
Missings	1 (0.3)
Age (mean in years)	53.54
Missings	2 (0.6)
Education (mean in years)	13.9
Missings	3 (1.0)
Time since injury (mean in months)	235
Missings	12 (3.9)
Level of lesion	
Paraplegia	217 (69.8)
Tetraplegia	91 (29.3)
Missings	3 (0.9)
Completeness of lesion	
Complete	158 (50.8)
Incomplete	152 (48.9)
Missings	1 (0.3)
Cause of injury	
Traumatic	250 (80.4)
Non-traumatic	47 (15.1)
Other cause	13 (4.2)
Missings	1 (0.3)

Note: Values are n(%).

Table 11. Descriptive characteristics of psychological resources, appraisals, coping and adjustment outcomes (N = 311).

Variable	Measure	Range	Mean (SD)	Cronbach's alpha	Missings n (%)
Psychological resources					
General Self-Efficacy	GSE	10 - 40	30.5 (5.4)	.91	14 (4.5)
Purpose in life	PIL-SF	4 - 28	22.6 (4.6)	.90	9 (2.9)
Mediating variables					
Appraisals					
Challenge	ALE	0 -30	13.4 (7.0)	.86	27 (8.7)
Loss	ALE	0 -20	7.1 (5.1)	.85	28 (9.0)
Threat	ALE	0 - 30	9.5 (6.6)	.85	29 (9.3)
Coping styles					
Self-distraction	Brief COPE	2 - 8	5 (−1.6)	.41	7 (2.3)
Active coping	Brief COPE	2 - 8	6.1 (1.4)	.74	4 (1.3)
Denial	Brief COPE	2 - 8	3.2 (1.5)	.65	10 (3.2)
Substance use	Brief COPE	2 - 8	2.6 (1.3)	.93	6 (1.9)
Emotional support	Brief COPE	2 - 8	4 (1.5)	.77	5 (1.6)
Instrumental support	Brief COPE	2 - 8	4.4 (1. 5)	.81	8 (2.6)
Behavioral disengagement	Brief COPE	2 - 8	3.1 (1.3)	.41	5 (1.6)
Venting	Brief COPE	2 - 8	4 (1.4)	.56	10 (3.2)
Positive reframing	Brief COPE	2 - 8	5.8 (1.6)	.61	8 (2.6)
Planning	Brief COPE	2 - 8	5.5 (1.4)	.47	10 (3.2)
Humor	Brief COPE	2 - 8	4.1 (1.6)	.71	9 (2.9)
Acceptance	Brief COPE	2 - 8	6.5 (1.4)	.66	11 (3.5)
Religion	Brief COPE	2 - 8	3.8 (2.0)	.90	9 (2.9)
Self-blame	Brief COPE	2 - 8	3.7 (1.4)	.52	7 (2.3)
Adjustment outcomes					
Depressive symptoms	HADS	0 - 21	4.2 (3.8)	.86	6 (1.9)
Participation	USER-P	11 - 55	37.9 (7.7)	.85	36 (11.6)
Quality of life	WHOQOL	5 - 25	19 (3.5)	.81	14 (4.5)

Note: Values are n(%). SD: standard deviation. Missings refer to missing total scores.

Table 12. Pearson correlations between psychological resources, appraisals, coping and adjustment outcomes.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 Self-efficacy	1.00																					
2 Purpose in life	0.58	1.00																				
3 Loss	-0.44	-0.34	1.00																			
4 Threat	-0.41	-0.27	0.72	1.00																		
5 Challenge	0.27	0.32	-0.27	-0.12	1.00																	
6 Self-distraction	-0.04	0.05	0.20	0.19	-0.01	1.00																
7 Active coping	0.30	0.48	-0.12	-0.09	0.10	0.23	1.00															
8 Denial	-0.12	-0.12	0.25	0.20	-0.03	0.32	-0.06	1.00														
9 Substance use	-0.15	-0.15	0.16	0.16	-0.01	0.10	-0.19	0.21	1.00													
10 Emotional Support	-0.04	0.03	0.20	0.23	0.06	0.19	0.17	0.12	0.09	1.00												
11 Instrumental Support	-0.01	0.07	0.20	0.19	0.01	0.21	0.27	0.03	-0.07	0.61	1.00											
12 Behavioral Disenga-gement	-0.21	-0.26	0.13	0.10	-0.10	0.12	-0.15	0.28	0.13	0.01	-0.05	1.00										
13 Venting	-0.03	-0.09	0.15	0.19	-0.03	0.09	0.00	0.10	0.05	0.51	0.38	0.06	1.00									
14 Positive Reframing	0.43	0.43	-0.25	-0.25	0.30	0.01	0.30	-0.11	-0.17	0.04	0.17	-0.11	0.00	1.00								
15 Planning	0.25	0.31	0.04	0.04	0.13	0.21	0.46	0.02	-0.08	0.23	0.34	-0.06	0.18	0.40	1.00							
16 Humor	0.27	0.17	-0.12	-0.08	0.22	0.01	0.05	-0.05	0.16	0.02	-0.02	-0.09	0.13	0.31	0.13	1.00						
17 Acceptance	0.38	0.33	-0.31	-0.24	0.17	-0.20	0.23	-0.37	-0.17	-0.15	-0.05	-0.16	-0.09	0.41	0.17	0.24	1.00					
18 Religion	-0.15	0.11	0.27	0.27	0.05	0.22	0.12	0.16	-0.08	0.08	0.21	0.10	0.02	0.13	0.14	-0.11	-0.04	1.00				
19 Self-blame	-0.05	-0.03	0.13	0.23	0.15	0.24	0.08	0.33	0.21	0.21	0.10	0.08	0.18	-0.02	0.25	0.08	-0.16	0.11	1.00			
20 Depression	-0.59	-0.65	0.46	0.41	-0.27	0.05	-0.29	0.35	0.15	0.06	-0.02	0.31	0.14	-0.43	-0.11	-0.28	-0.42	0.04	0.20	1.00		
21 Participation	0.28	0.24	-0.24	-0.21	0.24	0.00	0.21	-0.15	-0.04	-0.03	0.01	-0.13	-0.06	0.20	0.01	0.19	0.18	-0.05	0.02	-0.36	1.00	
22 Quality of life	0.51	0.58	-0.47	-0.39	0.27	-0.09	0.23	-0.24	-0.15	-0.06	-0.02	-0.15	-0.21	0.38	0.03	0.18	0.34	-0.09	-0.14	-0.69	0.41	1.00

Correlations r >.05 were significant at a 5% level. Correlations r >.15 were significant at a 1% level.

6.6. Figures

Figure 11. Initial hypothesized SEM model based on the SCIAM consisting of psychological resources, appraisals, coping and adjustment outcomes. Adjustment is a placeholder for the specific operationalizations quality of life, depressive symptoms and participation.

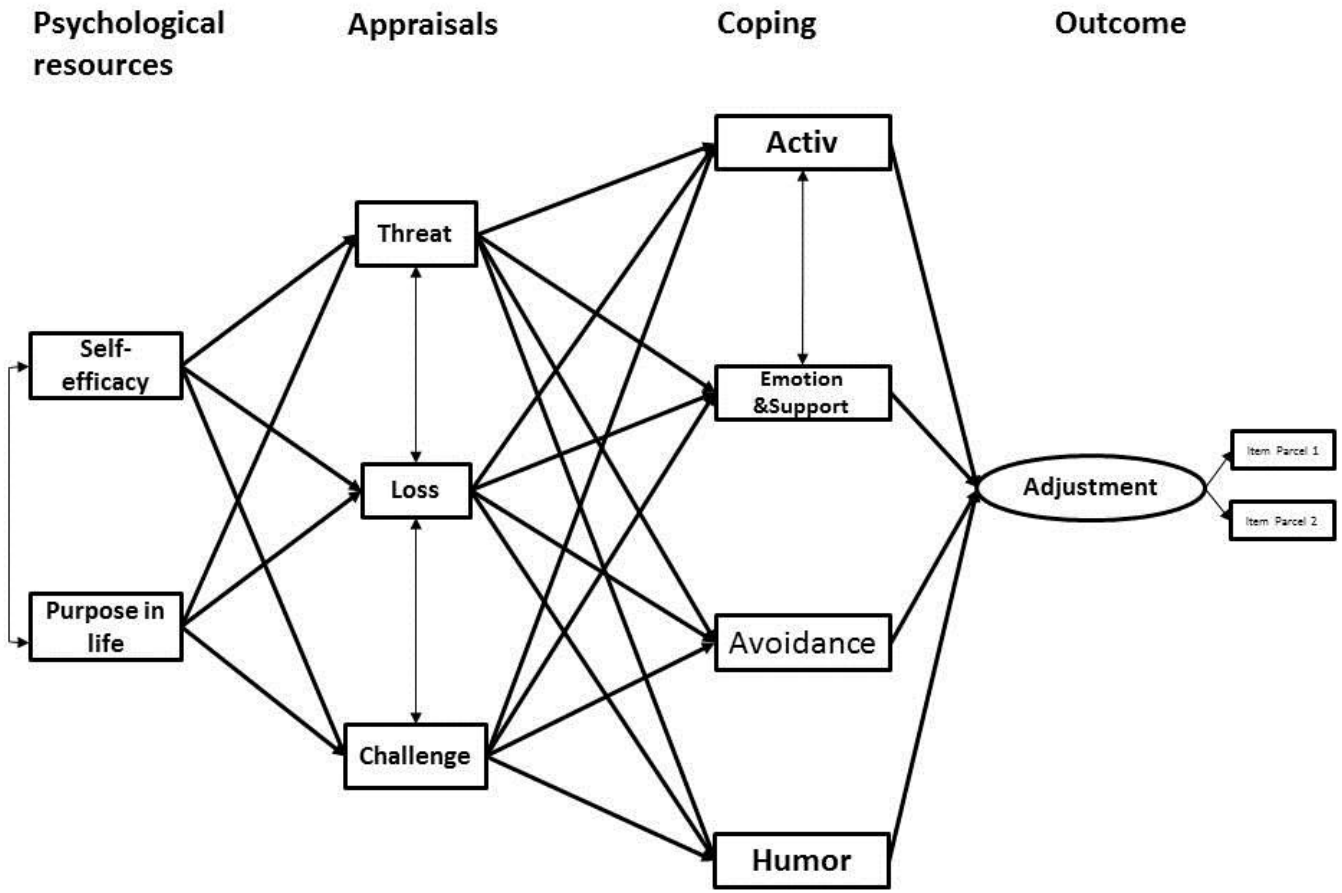
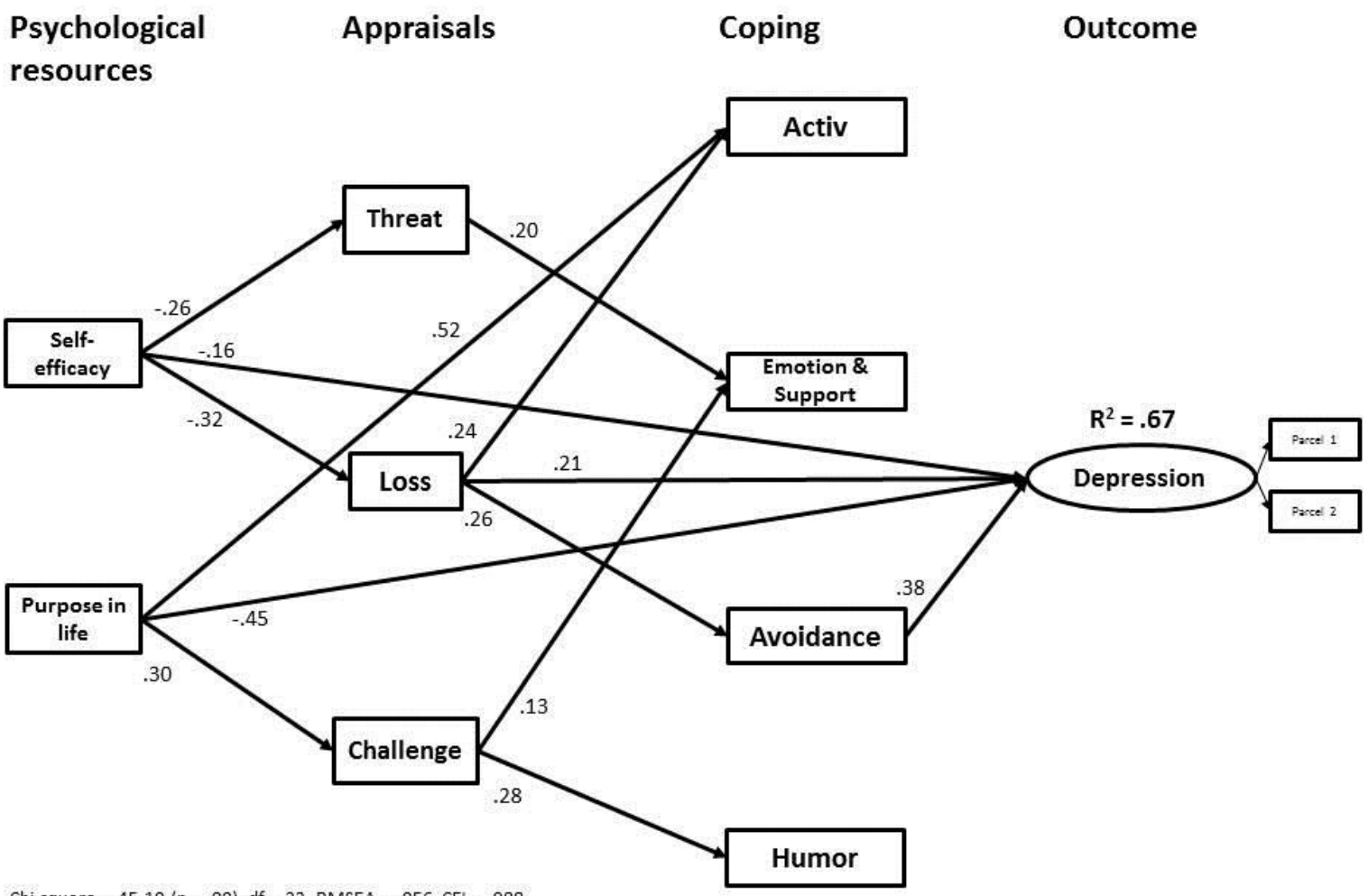
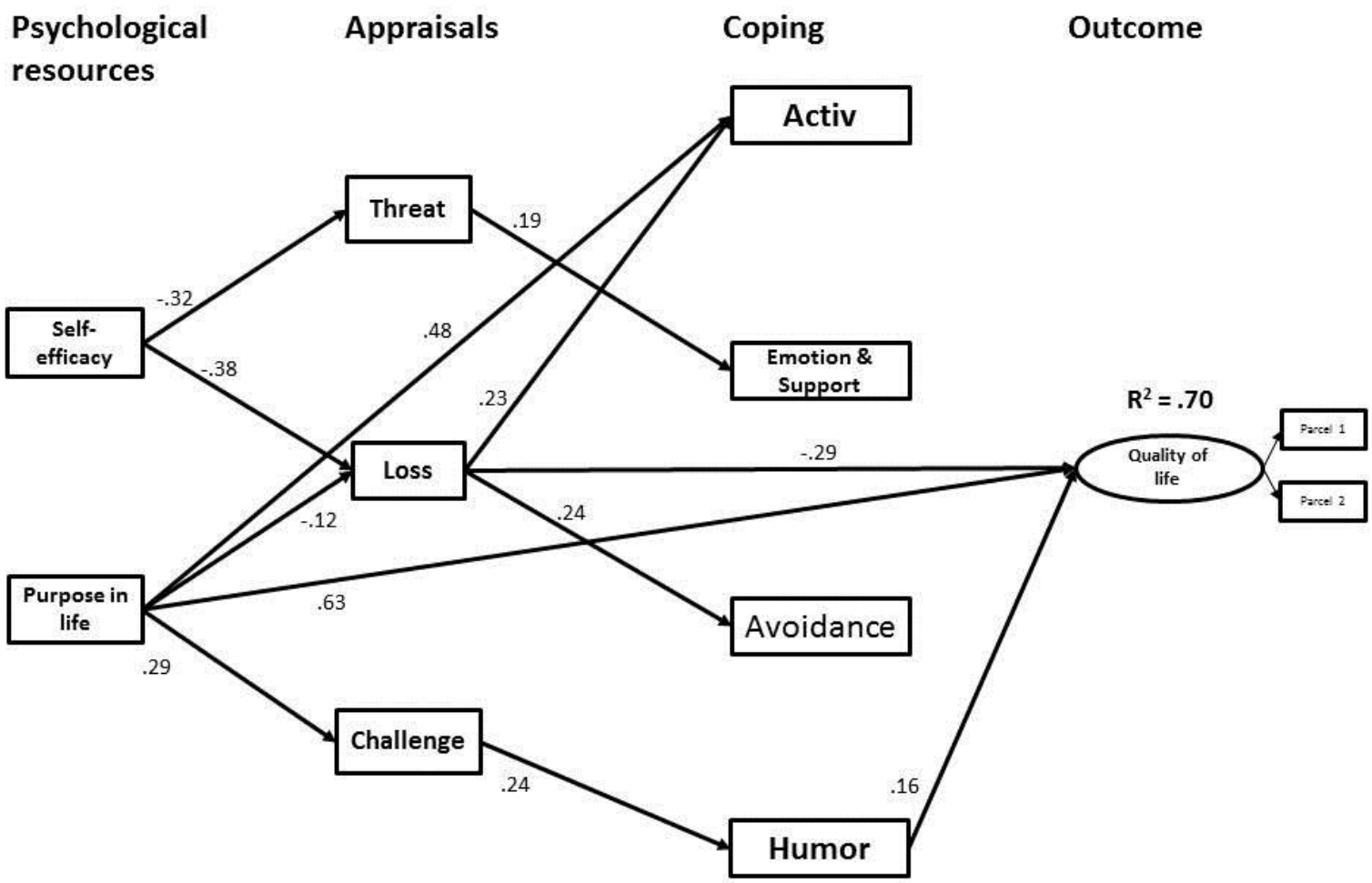


Figure 13. Final SEM model with symptoms of depression as adjustment outcome variable.



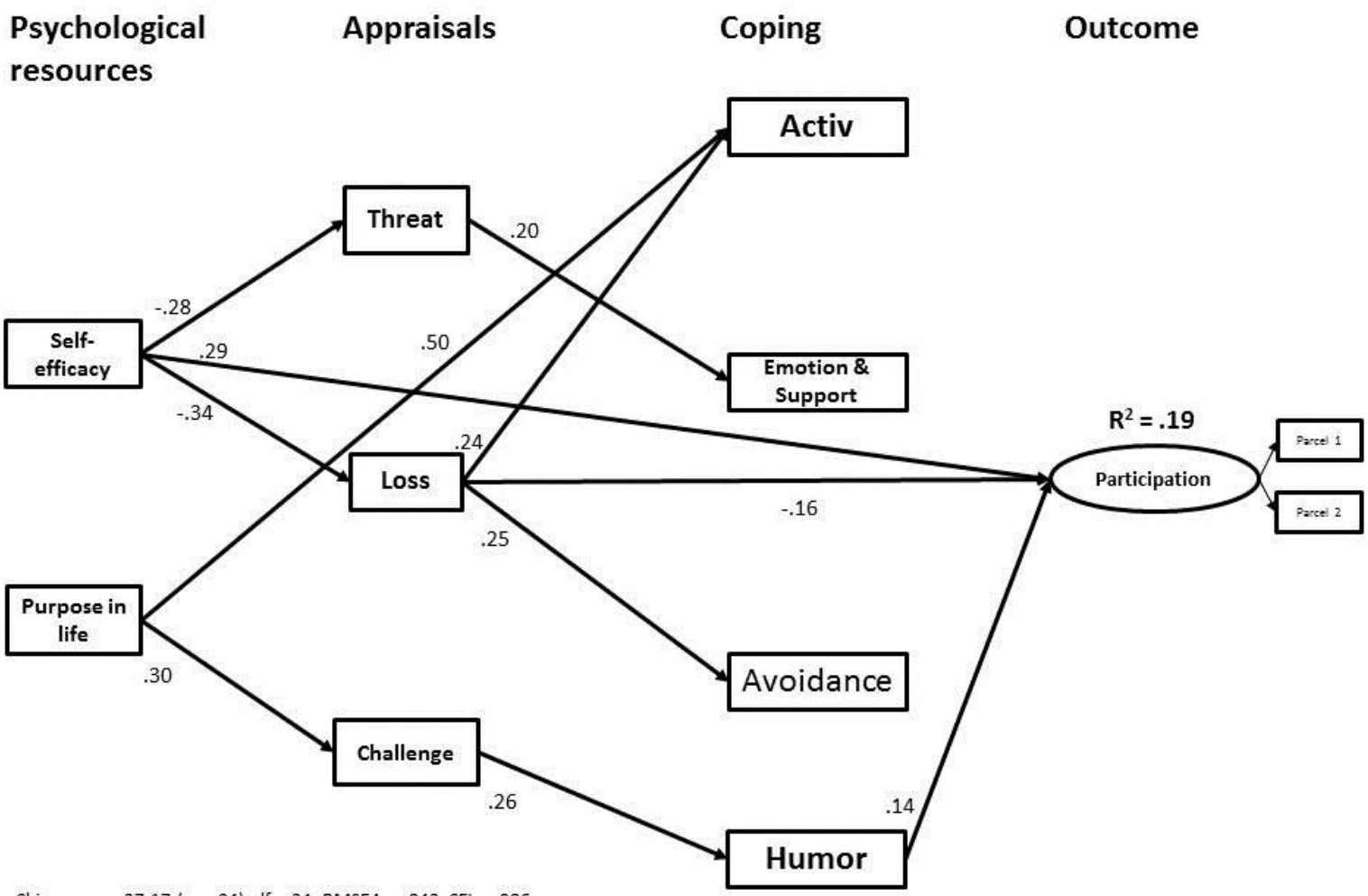
Chi-square = 45.10 (p = .00), df = 23, RMSEA = .056, CFI = .988.
For clarity of graph, the following non-significant paths are not depicted:
Self-efficacy -> Challenge; Purpose in life -> Threat; Purpose in life -> Loss; Threat -> Activ; Threat -> Avoidance; Threat -> Humor; Loss -> Emotion; Loss -> Humor; Challenge -> Activ; Challenge -> Avoidance; Activ -> Depression; Emotion -> Depression; Humor -> Depression.
The correlations between Self-efficacy and Purpose in life, Threat and Loss, Loss and Challenge, and Activ and Emotion are not depicted.

Figure 14. Final SEM model with quality of life as adjustment outcome variable.



Chi-square = 59.94 (p = .00), df = 24, RMSEA = .069, CFI = .959.
For clarity of graph, the following non-significant paths are not depicted:
Self-efficacy -> Challenge; Purpose in life -> Threat; Threat -> Activ; Threat -> Avoidance; Threat -> Humor; Loss -> Emotion; Loss -> Humor; Challenge -> Activ; Challenge -> Emotion; Challenge -> Avoidance; Activ -> Quality of life; Emotion -> Quality of life; Avoidance-> Quality of life.
The correlations between Self-efficacy and Purpose in life, Threat and Loss, Loss and Challenge, and Activ and Emotion are not depicted.

Figure 15. Final SEM model with participation as adjustment outcome variable.



Chi-square = 37.17 (p = .04), df = 24, RMSEA = .042, CFI = .986.
For clarity of graph, the following non-significant paths are not depicted:
Self-efficacy -> Challenge; Purpose in life -> Threat; Purpose in lief -> Loss; Threat -> Activ; Threat -> Avoidance; Threat -> Humor; Loss -> Emotion; Loss -> Humor; Challenge -> Activ; Challenge -> Emotion; Challenge -> Avoidance; Activ -> Participation; Emotion -> Participation; Avoidance -> Participation.
The correlations between Self-efficacy and Purpose in life, Threat and Loss, Loss and Challenge, and Activ and Emotion are not depicted.

7. General discussion

The role of psychological resources in persons with SCI was the main focus of this doctoral thesis. The reasons for concentrating on these characteristics inherent to the person were twofold. First, adjustment models depicting the adjustment process after SCI incorporate psychological resources as determinants of adjustment outcomes [36]. The theoretical premise is that psychological resources alleviate adjustment to the injury by buffering the effect of stressors, by influencing how they are appraised and by which coping behaviors are adopted, or by directly influencing a person's health or quality of life. Second, strengthening psychological resources is an important aim in clinical rehabilitation and part of everyday psychological practice [52]. Evidence, however, lags behind clinical psychological work.

The present doctoral thesis aimed to close this gap. The objective of the first study was to investigate the role of psychological resources after SCI and examine their relationship with other factors and outcomes of the adjustment process.

To demonstrate the targeted integration of psychological resources in the context of interdisciplinary clinical rehabilitation of spinal cord injury was the objective of the second study. The beneficial effect of the inclusion of psychological resources was illustrated in a case study.

Psychological resources need reliable and valid measurement instruments in order to convincingly report associations with other variables. The examination of one widely used measurement instrument, the General Self-Efficacy Scale, using Rasch analysis was the response to this call.

The objective of the fourth study was to examine whether and, if so, how psychological resources interact with cognitive appraisals, coping and the adjustment outcomes quality of life, participation and symptoms of depression. For this purpose a nation-wide, cross-sectional study was conducted.

A person's quality of life, mental health as well as the extent to which a person with SCI participates is related with the level of the psychological resources inherent to that person. Results of the systematic literature review (study 1), the case study (study 2) and the empirical study (study 3) generally show these findings.

The systematic literature review clearly revealed that strong psychological resources are generally linked to better quality of life and mental health, while associations with participation and physical health are rarely examined and overall inconclusive. Some psychological resources such as self-efficacy and self-esteem gained large attention in SCI research, others, such as purpose in life or optimism were only investigated in single studies. Studies were mainly conducted with persons living in the community, which does not allow for generalization to the acute or post-acute phase in the clinical rehabilitation setting.

However, as shown in the case study, targeted inclusion of psychological resources, which interestingly did not show up in the systematic literature review, yielded positive results in the clinical rehabilitation context by contributing to stress reduction. A patient's curiosity as well as his musicality were targeted and included in the rehabilitation process, for example, by giving him the choice of certain interventions with regards to his severe stress experience or by enabling to express his musicality by playing guitar in musical therapy. This early inclusion not only contributed to stress reduction but also gave the patient a sense of being understood and respected, which in turn improved the collaboration with all health professionals.

The results of the empirical study largely correspond with the findings of the systematic literature review: self-efficacy and purpose in life acted as determinants of high quality of life, mental health and participation. Two aspects are notable: First, purpose in life had a much higher impact on quality of life and the level of depressive symptoms than self-efficacy, which is somewhat surprising considering the results of the systematic literature review, where self-efficacy was, among all psychological resources, most consistently associated with better quality of life and mental health. Second, while purpose in life and self-efficacy together with loss appraisals played a central role in the adjustment mechanism, coping styles hardly had an impact on the adjustment outcomes. This supports past research emphasizing the role of cognitive appraisals, but contradicts research findings in which coping strategies were identified as important source and determinant of adjustment [20, 51]. However, only few studies had a multifactorial design including psychological resources, appraisals and coping behavior and the relevance of coping might be more significant in the immediate presence of a stressor as in the acute-phase after SCI. Hence, the

role of coping styles should not be a priori underestimated but followed longitudinally, under simultaneous consideration of other adjustment factors.

The theoretical conceptualization and description of the SCI adjustment process was the foundation of the present doctoral thesis. Study 4 of this doctoral thesis suggests that the Spinal Cord Injury Adjustment Model (SCIAM) is not necessarily a correct framework for describing adjustment after SCI: direct paths from psychological resources and appraisals to adjustment outcomes are not in line with the model in which solely mediating effects are hypothesized [36]. The results better correspond with the SAC model, in which both direct and indirect paths are assumed [20]. The direct and indirect paths indicate that there is not just one single adjustment mechanism representing how something works for all variables at the same time. More likely, the nature of the psychological resources, appraisals or outcomes, i.e. what they are, determines whether effects are, if, to be expected and whether they’re mediated or not. For example, purpose in life did not have a direct impact on quality of life because psychological resources all have, but because striving for meaning, as suggested by V. Frankl [49], might be the most powerful driving force in humans and therefore closely connected to high quality of life, if adopted.

Findings of study 3 of the current doctoral thesis supported the good psychometric properties of the General Self-Efficacy Scale. The application of Rasch analyses, a modern-test theoretical approach, adds to the validation tests that were up to now mainly based on classical test-theoretical methods [e.g. 236]. Although the psychometric criteria of the measure were satisfactory, the number of items could be reduced, as the mean item difficulties laid close to each other. The use of a shortened version could reduce respondent burden in survey and potentially increase response rate.

Research on psychological resources can solely lead to clinically justifiable and scientifically steady results if reliable measurement instruments are used. Psychometric properties of measures of psychological resources should closely be inspected by the use of modern test-theoretical approaches such as Rasch analysis. One main distinct advantage of Rasch analysis is the transformation of ordinal scale observations into interval scale measures. As this approach is confirming the additivity of a total score, it is an essential necessity for any

research conducting analyses with total scores, especially if changes are to be assessed as in intervention studies or longitudinal studies.

The results of the current doctoral thesis may serve as the basis for the development of systematic interventions aiming at strengthening psychological resources in persons with SCI. For that purpose, a well-directed focus on comparably well-known concepts such as self-efficacy and purpose in life seems indicated, because they're associated with better quality of life, mental health and more participation, as suggested by the findings of the systematic literature review and the empirical study. However, as shown in the case study, less investigated variables such as musicality could significantly improve a person's state of being, too.

Interventions targeting enhancements in purpose in life may consist of different intervention strategies, only partially show promising results, have been increasingly conducted with persons with cancer, but not with persons with SCI. A psychosocial counseling intervention did not lead to changes in the experience purpose in life for persons with cancer [300]. A Life review intervention consisting of purposeful reminiscences including meeting past friends, visiting previous home sites, or reviews of personal documents of the past improved the level of purpose in life in a non-significant manner for persons with HIV disease [301]. The "Meaning Centered Group Psychotherapy (MCGP)" is closely tied to V. Frankl's theoretical underpinnings and consists of different sessions focusing around particular themes related to meaning such as concepts of meaning, meaning derived from attitudinal values or from the historical context of life [163]. Clear evidence with regards to the success of the MCGP in cancer patients is still lacking.

Targeted self-efficacy enhancement has received more attention in SCI research. Successful improvements in self-efficacy were achieved with an active/independent living program [88, 89], physical activity or sports programs [74, 79, 90], or a wellness workshop intervention [91].

Successful intervention programs frequently apply a multi-factorial approach. Primary characteristics of successful self-efficacy-enhancing interventions for persons with chronic health conditions were identified: 1) utilization of a variety of learning strategies, 2) involvement of significant others, 3) fostering self-management in various domains such as exercise or weight

control, 4) application of encouragement, persuasion and support, 5) fostering self-appraisal and problem-solving ability to deal with various different disease-related issues, 6) usage of trained educators and both an individual and small-group intervention [168]. For the clinical setting, strategies for the clinicians to strengthen self-efficacy of the patients with chronic health conditions can be incorporated in daily practice and include 1) reinforcing past and present successes, 2) directing patients to observe successful behaviors of similar others, 3) providing positive feedback for the patient's efforts, 4) facilitating the adoption of new health behaviors by ensuring no false interpretation of personal feelings [168].

Several aspects for conducting interventions on psychological resources need to be considered: Multi-factorial approaches, although seeming fruitful, might obnubilate why something works. Taxonomies depicting the specific components of interventions might help to identify the responsible "piece" for the enhancement of a psychological resource [303]. Interventions can be implemented in the clinical and community setting, but should avoid overwhelming persons with SCI, especially in the early phase of their injury. Study participants should not develop the impression of being blamed for potential stagnation and lacking improvements. Interventions might need to be targeted to be successful. In the case study the participant received musical therapy because it corresponded with his psychological resource, his musicality. However, it is not to be expected that interventions work for everybody. Attempts of such systematic resource enhancements programs represent major planning and organizational efforts. However, personal gains of the participants such as increased health and well-being may also have a lowering effect on health care costs and utilization [168].

Overall, enhanced efforts in the research area of psychological resources in persons with SCI are indicated. First, research is so far fragmented and mainly focused on self-efficacy or self-esteem. This led to considerable knowledge; however, research encompassing the whole variety of psychological resources should be intensified, because, as seen in the case study, other psychological resources such as curiosity can also enhance a person's well-being if targeted. Second, longitudinal studies starting in the early-acute phase are needed to clearly infer causality and to depict the role of psychological resources in the first

months after injury, but also in the long-term context. Third, only few studies examined the proposed mechanism underlying SCI by including several factors such as psychological resources, appraisals and coping behavior at the same time. Multifactorial studies with the identification of distinct SCI-related stressor may yield a clearer picture with regards to the role of all adjustment factors. Especially with regards to the adjustment outcome participation, the additional inclusion of environmental or biological factors might yield additional insights. Fourth, validations of measurement instruments using modern test-theoretical approaches should be intensified in order to provide reliable measures suitable for identifying potential changes in the years after SCI.

The current doctoral thesis provided sound evidence for the significance of psychological resources in persons with SCI, both in the short-term as also in the long-term context after the injury. It is the hope that the collected evidence can serve as basis for the targeted support of persons with SCI.

8. Summary

Spinal cord injury (SCI) is a health condition with severe life-changing consequences on a physical, social and psychological level [1, 2]. SCI can result in permanent loss of motor and sensory function corresponding to the level of the spinal lesion. These severe physical consequences also reverberate on the level of everyday activities as well as societal participation [13-15] and may also exert a negative impact on mental health.

SCI adjustment models describe how persons adjust to their injury and the connected consequences. According to the Spinal Cord Injury Adjustment Model (SCIAM) psychological, biological, and environmental factors interact and determine adjustment outcomes such as quality of life, stress experience, mental health or participation via cognitive appraisal and coping processes [36]. Psychological resources are seen as one important determinant of these adjustment outcomes after SCI.

Psychological resources are defined as inner, health protecting and health promoting potentials of a person, which represent a source or means to deal with difficult situations or obtain valued ends [43-46]. Psychological resources and their interaction with the other factors of the adjustment process such as appraisals and coping behavior play a key role in the determination of the adjustment outcomes. However, the underlying mechanism remains unclear, as evidence with regards to psychological resources in persons with SCI is weak at best [20, 51].

The general objective of the current doctoral thesis is to gain an in-depth understanding about the adjustment process in SCI while focusing on psychological resources and their interaction with cognitive appraisals, coping and the adjustment outcomes mental health, stress experience, quality of life and participation.

Study 1: Psychological resources in spinal cord injury: A systematic literature review

The objective of this study is to investigate the role of psychological resources after SCI and examine their relationship with other factors and outcomes of the adjustment process.

A systematic literature review was performed. The literature search was conducted in the databases Pubmed, PsycINFO, the Social Sciences Citation Index, the Education Resources Information Center, Embase and the Citation Index of Nursing and Allied Health Literature. The assessed variables, measurement instruments, results and the methodological quality of the studies were extracted, summarized and evaluated.

A total of 83 mainly cross-sectional studies were identified. Psychological resources were categorized into seven groups: self-efficacy, self-esteem, sense of coherence, spirituality, optimism, intellect and other personality characteristics. Self-efficacy and self-esteem were consistently associated with positive adjustment indicators such as high well-being and better mental health. Interrelations between psychological resources and key rehabilitation outcome variables such as participation were rarely studied. Only a few interventions, which were aimed at strengthening psychological resources were identified. Longitudinal studies suggested that self-efficacy, sense of coherence, spirituality and purpose in life were potential determinants of adjustment outcomes in the long term.

Research on psychological resources in SCI is broad, but fragmented. Associations of psychological resources with mental health and well-being were frequently shown, while associations with participation were rarely studied. Further development of resource-based interventions to strengthen persons with SCI is indicated.

Study 2: Stress, psychological resources and functioning in a person with spinal cord disease

The objective of this study is to demonstrate the targeted integration of psychological resources in the context of interdisciplinary clinical rehabilitation of spinal cord injury.

A single case study was conducted with a person with SCI. The International Classification of Functioning, Disability and Health (ICF) was used as a framework to depict functioning and disability level of the patient at the beginning and towards the end of rehabilitation. Qualitative data was collected by conducting interviews with patient and health professionals. Quantitative data was retrieved from medical records. ICF-based documentation tools were used to

structure information about the level of functioning regarding body functions and structures, activity and participation, environmental and personal factors including psychological resources.

Strengthening psychological resources contributed to stress reduction in the rehabilitation of a person with SCI. The patient's curiosity as well as his musicality were targeted and included in the rehabilitation process, for example, by giving him the choice of certain interventions with regards to his severe stress experience or by enabling to express his musicality by playing guitar in musical therapy. Active involvement in decision taking increased the patient's perceived self-determination and reduced stress.

This study showed that psychological resources should be targeted and integrated into the rehabilitation process when aiming at stress reduction in a patient with SCI. ICF-based documentation tools supported this undertaking by making the role of psychological resources and the change in functioning explicit.

Study 3: Rasch analysis of the General Self-Efficacy Scale (GSES) in spinal cord injury (SCI)

The objective of this study is to examine the psychometric properties of the General Self-Efficacy Scale (GSES) using Rasch analysis in a German-speaking sample with SCI living in Switzerland.

The psychometric evaluation of the GSES was conducted using cross-sectional data from a multi-center study including 101 persons with SCI. Rasch analysis was carried out to test unidimensionality, reliability, structure of the response scale, targeting of the instrument and item bias or differential item functioning (DIF) with regards to age, gender, education and level of injury.

The GSES showed an overall fit to the Rasch model, indicating unidimensionality. The person reliability index had a value of 0.92 which indicates high reliability. The structure of the response scale was satisfactory. No reversed thresholds on any item were observed; the thresholds showed the expected pattern of increasing values. Regarding targeting, item means appeared to be "clustered", whereas item thresholds were spread along the self-efficacy continuum. Out of the original valid 101 scores, 2 persons (2 %) scored below the lowest threshold, while 17 persons (16.8%) scored higher than the highest threshold, altogether indicating a ceiling effect. Differential item

functioning was not indicated. Post-hoc exploratory Rasch analysis including only five items of the GSES selected to maximize spread across the self-efficacy continuum resulted in a satisfactory reliability of 0.82.

The GSES is a unidimensional and reliable measurement instrument. The response scale structure was ordered. All items worked consistently across gender, age, education and lesion levels. However, the results indicate that the differentiation across self-efficacy levels could be enhanced and the measurement instrument could be shortened.

Study 4: Modeling adjustment in spinal cord injury: the role of psychological resources

The objective of this study is to examine whether and, if so, how psychological resources interact with cognitive appraisals, coping and the adjustment outcomes quality of life, participation and depressive symptoms.

A community-based cross-sectional survey was conducted. Persons with a traumatic or non-traumatic spinal cord injury, aged 16 years or older, and living in Switzerland were eligible for the study. The psychological resources general self-efficacy (measured with the General Self-Efficacy Scale) and purpose in life (Purpose in life Scale – Short Form) were assessed. The outcome variables of this study were depressive symptoms (Hospital Anxiety and Depression Scale), quality of life (WHOQoL, selected items) and participation (Utrecht Scale for Evaluation of Rehabilitation-participation). Cognitive appraisals and coping styles were assessed as potential mediating variables. Data was analyzed using structural equation modelling (SEM). One SEM-model per outcome variable (participation, quality of life, depressive symptoms) was specified.

Data was obtained of 311 persons with SCI. Purpose in life correlated significantly with participation ($r = .24$), symptoms of depression ($r = -.65$) and quality of life ($r = .58$). General self-efficacy was significantly associated with participation ($r = .28$), depressive symptoms ($r = -.59$), and quality of life ($r = .51$).

The final model for symptoms of depression had a good model fit ($\chi^2 = 45.10$, $p = .00$, $df = 23$, $\chi^2 / df < 2.5$, $RMSEA = .056$, $CFI = .988$) with purpose in life ($\beta = -.45$) and loss appraisals ($\beta = .21$) having a significant direct effect on depressive symptoms. In the model 67 % of variance of symptoms of depression

was explained. The final model for quality of life had a good model fit (χ^2 = 59.94, p = .00, df = 24, χ^2 / df < 2.5, RMSEA = .069, CFI = .959) explaining 70 % of variance of quality of life. Purpose in life was directly related to quality of life with a path coefficient indicating a large effect (β = .63). The influence of self-efficacy on quality of life was mediated by loss appraisals. The final model for participation had a good model fit (χ^2 = 37.17, p = .04, df = 24, χ^2 / df < 2.5, RMSEA = .042, CFI= .986) explaining 19 % of variance of participation. Self-efficacy was directly related to participation (β = .29), the influence of purpose in life on participation was indirect.

The psychological resources purpose in life and self-efficacy are significantly related to adjustment having a direct effect on depressive symptoms, quality of life, and participation. Loss appraisals hold a central role in the adjustment mechanism, whereas coping styles only play a minor role.

General discussion

The general objective of the current doctoral thesis was to gain an in-depth understanding about the adjustment process in SCI while focusing on psychological resources.

Results of the systematic literature review (study 1), the case study (study 2) and the empirical study (study 4) support the important role of psychological resources in the SCI adjustment process. The systematic literature review revealed that strong psychological resources are linked to better quality of life and mental health. Targeted inclusion of the psychological resources curiosity and musicality yielded positive results in the clinical rehabilitation context by contributing to a patient's stress reduction and by giving him a sense of being understood and respected, which in turn improved the collaboration with all health professionals. The empirical study showed that self-efficacy and purpose in life determine high quality of life, mental health and participation, wherein the effect of purpose in life was the strongest observed. Purpose in life and self-efficacy together with loss appraisals played a central role in the adjustment mechanism, coping strategies, however, hardly had an impact on the adjustment outcomes. This supports past research emphasizing the role of cognitive appraisals, but contradicts research findings in which coping strategies were identified as important source and determinant of adjustment [20, 51]. The

Spinal Cord Injury Adjustment Model (SCIAM) is not necessarily a correct framework for describing adjustment after SCI because appraisals and coping did not consistently act as mediators between psychological resources and adjustment outcomes [36].

Good psychometric properties were found for the General Self-Efficacy Scale; however, the number of items could be decreased. The use of a shortened version could reduce respondent burden in survey and potentially increase response rate.

Overall, research on psychological resources is fragmented, mainly focused on self-efficacy, but should extent the focus to other psychological resources such as curiosity. Longitudinal studies starting in the early-acute phase of SCI are needed to clearly infer causality. Only few studies examined the adjustment process and its underlying mechanism comprehensively. Validations of measurement instruments using modern test-theoretical approaches should be intensified in order to provide reliable measures for psychological resources.

The current doctoral thesis provided sound evidence for the significance of psychological resources in persons with SCI and may serve as the basis for the development of systematic interventions aiming at strengthening psychological resources in persons with SCI.

9. Zusammenfassung

Rückenmarksverletzungen (RMV) sind Gesundheitsstörungen mit schwerwiegenden Folgen auf körperlicher, sozialer und psychischer Ebene [1, 2]. RMV können je nach Ausmaß und Höhe der Läsion dauerhafte Verluste in den motorischen und sensorischen Funktionen nach sich ziehen. Diese schwerwiegenden körperlichen Konsequenzen wirken sich auf die täglichen Aktivitäten und auf die Partizipation aus [13-15] und können auch einen negativen Einfluss auf die mentale Gesundheit ausüben.

Das SCI Adjustment Model (SCIAM) beschreibt den psychosozialen Anpassungsprozess nach einer RMV. Psychologische, biologische, und umweltbezogene Faktoren beeinflussen Anpassungsfolgen wie die Lebensqualität, den wahrgenommenen Stress, die mentale Gesundheit oder Partizipation über kognitive Bewertungs- und Bewältigungsprozesse [36]. Psychologische Ressourcen sind wichtige Determinanten dieser Anpassungsfolgen nach einer RMV.

Psychologische Ressourcen werden als innere, gesundheitsschützende oder –förderne Potenziale einer Person definiert. Sie stellen eine Quelle oder ein Mittel dar, um mit schwierigen Situationen umzugehen oder wichtige Ziele zu erreichen [43-46]. Psychologische Ressourcen und ihre Interaktionen mit den weiteren Faktoren des Anpassungsprozesses wie beispielsweise der kognitiven Bewertung oder den Bewältigungsstrategien (coping) spielen eine Schlüsselrolle in der Bestimmung der Anpassungsfolgen. Der dahinterliegende Anpassungsmechanismus bleibt jedoch unklar, da wissenschaftliche Belege bezüglich psychologischer Ressourcen fragmentiert und bestenfalls als schwach einzustufen sind [20, 51].

Das übergreifende Ziel der vorliegenden Dissertation ist es, ein vertieftes Verständnis des psychosozialen Anpassungsprozesses nach einer RMV zu erhalten, wobei der Fokus auf die psychologischen Ressourcen liegt. Im Zentrum stehen die Interaktionen ausgewählter psychologischer Ressourcen mit der kognitiven Bewertung, den Bewältigungsstrategien und den Anpassungsfolgen mentale Gesundheit, wahrgenommener Stress, Lebensqualität sowie der Partizipation.

Studie 1: Psychologische Ressourcen bei Rückenmarksverletzungen: ein systematischer Literaturreview

Das Ziel dieser Studie ist es, die Rolle psychologischer Ressourcen nach einer RMV zu untersuchen und die Beziehungen mit anderen Faktoren und Folgen des Anpassungsprozesses zu ermitteln.

Ein systematischer Literaturreview wurde durchgeführt. Die Literatursuche erfolgte in den Datenbanken Pubmed, PsycINFO, dem Social Sciences Citation Index, dem Education Resources Information Center, Embase und dem Citation Index of Nursing and Allied Health Literature. Die gemessenen Variablen, die verwendeten Messinstrumente, die Resultate sowie die methodologische Qualität der Studien wurden extrahiert, zusammengefasst und evaluiert.

Insgesamt 83 Studien, hauptsächlich Querschnitterhebungen, wurden identifiziert. Die psychologischen Ressourcen wurden in 7 Gruppen eingeteilt: Selbstwirksamkeit, Selbstwert, Kohärenzgefühl, Spiritualität, Optimismus, Intellekt und andere Persönlichkeitscharakteristiken. Die Selbstwirksamkeit sowie der Selbstwert waren durchwegs mit Indikatoren einer positiven Anpassung verbunden, wie beispielsweise hoher Lebensqualität und guter mentaler Gesundheit. Zusammenhänge zwischen psychologischen Ressourcen sowie Verbindungen mit zentralen Anpassungsfolgen wie der Partizipation wurden selten untersucht. Nur wenige Interventionsstudien wurden gefunden, welche die Stärkung psychologischer Ressourcen zum Ziel hatten. Längsschnittstudien deuteten darauf hin, dass Selbstwirksamkeit, Kohärenzgefühl, Spiritualität und Lebenssinn potentielle Determinanten der späteren Anpassung sind.

Der Forschungsstand bezüglich psychologischer Ressourcen bei Menschen mit einer RMV ist breit, aber fragmentiert. Zusammenhänge zwischen psychologischen Ressourcen mit mentaler Gesundheit und Lebensqualität wurden wiederholt festgestellt, während mögliche Zusammenhänge mit der Partizipation kaum untersucht wurden. Anstrengungen bezüglich der Entwicklung von ressourcenbasierten Interventionen zur Stärkung der Menschen mit einer RMV sind indiziert.

Studie 2: Stress, psychologische Ressourcen und Funktionsfähigkeit bei Menschen mit einer Rückenmarksverletzung

Das Ziel der Studie ist, die gezielte Einbindung psychologischer Ressourcen im Kontext einer interdisziplinären klinischen Rehabilitation nach einer RMV aufzuzeigen.

Es wurde eine Fallstudie mit einer Person mit einer RMV durchgeführt. Die Internationale Klassifikation der Funktionsfähigkeit, Behinderung und Gesundheit (ICF) wurde als Bezugssystem verwendet, um die Funktionsfähigkeit und den Behinderungsgrad eines Patienten zu Beginn und gegen Ende der Rehabilitation darzustellen. Qualitative Daten wurden durch Interviews mit dem Patienten sowie dem Gesundheitspersonal erfasst. Quantitative Daten wurden aus den medizinischen Akten gewonnen. ICF-basierte Dokumentationsformulare wurden verwendet, um Informationen zum Grad der Funktionsfähigkeit bezüglich den ICF-Komponenten der Körperfunktionen und Körperstrukturen, Aktivitäten und Partizipation, sowie den umweltbezogenen und personenbezogenen Faktoren inklusive psychologischer Ressourcen zu strukturieren.

Die Stärkung psychologischer Ressourcen innerhalb der Rehabilitation trug wesentlich zur Reduktion von Stress bei der Person mit der RMV bei. Die Neugier sowie die Musikalität des Patienten wurden gezielt als Ressourcen in den Rehabilitationsprozess mit einbezogen. So wurde beispielsweise dem Patienten die Wahl zwischen bestimmten Interventionen zur Stressreduktion gelassen oder man bot ihm die Gelegenheit, seine Musikalität auszudrücken, indem er in der Musiktherapie Gitarre lernen konnte. Eine aktive Miteinbeziehung in die Entscheidungsfindung stärkte die Selbstbestimmung des Patienten und verminderte den subjektiv wahrgenommenen Stress.

Die Studie weist darauf hin, psychologische Ressourcen gezielt in den Rehabilitationsprozess zu integrieren, wenn bei einem Patienten der subjektiv wahrgenommene Stress reduziert werden soll. ICF-basierte Dokumentationsmittel unterstützen dieses Vorhaben, indem sie die Rolle psychologischer Ressourcen hervorheben und Veränderungen in der Funktionsfähigkeit darstellen.

Studie 3: Rasch Analyse der Skala zur Allgemeinen Selbstwirksamkeitserwartung (GSES) bei Menschen mit einer Rückenmarksverletzung

Das Ziel dieser Studie ist es, die psychometrischen Gütekriterien der Skala zur Allgemeinen Selbstwirksamkeitserwartung zu überprüfen. Zu diesem Zweck wurde eine Rasch Analyse mit einer deutsch-sprachigen, in der Schweiz wohnhaften Stichprobe von Menschen mit einer RMV durchgeführt.

Die psychometrische Evaluation der GSES wurde mit Daten aus einer multizentrischen Querschnittstudie von insgesamt 101 Personen mit einer RMV durchgeführt. Mittels Rasch-Analyse wurde die Unidimensionalität, die Reliabilität, die Struktur der Antwortskala, das Targeting des Messinstrumentes sowie systematische Verzerrungstendenzen (differential item functioning DIF) hinsichtlich des Alters, Geschlechts, Bildung und Läsionshöhe getestet.

Die GSES zeigte einen guten Fit zum Rasch-Modell, was auf Unidimensionalität hindeutet. Der Personen-Reliabilitätsindex hatte einen Wert von .92, was auf eine hohe Reliabilität schließen lässt. Die Struktur der Antwortskala war zufriedenstellend. Umgekehrte Schwellenwerte wurden bei keinem Item festgestellt; die Schwellenwerte zeigten das erwartete Muster von steigenden Werten. Die Werte für die durchschnittliche Schwierigkeit der Items schienen sich um den gleichen Wert zu konzentrieren, wogegen die Schwellenwerte der Antwortskala über das ganze Selbstwirksamkeitskontinuum hinweg verteilt waren. Von den 101 Personen erzielten zwei Personen (2 %) einen Wert unter dem tiefsten Schwellenwert, während 17 (16.8 %) einen Wert höher als der höchste Schwellenwert erzielten, was bezüglich des Targetings insgesamt auf einen Deckeneffekt hindeutet. Systematische Verzerrungstendenzen wurden nicht beobachtet. Post-hoc explorative Rasch-Analysen mit nur 5 Items der GSES, welche maximal auf dem Selbstwirksamkeits-Kontinuum verteilt waren, resultierten in einer zufriedenstellenden Reliabilität von 0.82.

Die GSES ist ein unidimensionales und reliables Messinstrument im Bereich der RMV. Die Antwortskala ist geordnet. Alle Items funktionieren konsistent über Geschlecht, Alter, Bildung und Läsionshöhe. Allerdings implizieren die Resultate, dass die Differenzierung über das Selbstwirksamkeitskontinuum hinweg erhöht werden und das Messinstrument gekürzt werden könnte.

Studie 4: Modellierung der psychosozialen Anpassung nach einer Rückenmarksverletzung: Die Rolle psychologischer Ressourcen

Das Ziel der Studie ist es zu untersuchen, wie psychologische Ressourcen mit kognitiven Bewertungen, Bewältigungsstrategien (coping) und den Anpassungsfolgen Lebensqualität, Partizipation und depressive Symptome interagieren.

Eine gemeindebasierte Querschnittstudie wurde durchgeführt. Alle Personen mit einer traumatischen oder nicht-traumatischen RMV, älter als 16 Jahre und in der Schweiz wohnhaft, waren für diese Studie teilnahmeberechtigt. Als psychologische Ressourcen wurden die generelle Selbstwirksamkeit (gemessen mit der Skala zur Allgemeinen Selbstwirksamkeitserwartung) sowie Lebenssinn (Purpose in life Scale – Kurzversion) gemessen. Als abhängige Variablen wurden depressive Symptome (Hospital Anxiety und Depression Scale), Lebensqualität (WHOQoL, selektionierte Items) und Partizipation (Utrecht Scale for Evaluation of Rehabilitation-Participation) ermittelt. Kognitive Bewertungen sowie Bewältigungsstrategien wurden als potenzielle Mediatorvariablen mit einbezogen. Die Daten wurden mittels Strukturgleichungsmodellen (SEM) analysiert. Es wurde ein SEM-Modell pro abhängige Variable (Partizipation, Lebensqualität, depressive Symptome) berechnet.

Daten von 311 Personen mit RMV wurden ausgewertet. Die Lebenssinn-Skala korrelierte signifikant mit Partizipation ($r = .24$), depressiven Symptomen ($r = -.65$) und Lebensqualität ($r = .58$). Die Selbstwirksamkeit stand signifikant mit Partizipation ($r = .28$), depressiven Symptomen ($r = -.59$), und Lebensqualität ($r = .51$) in Zusammenhang.

Das Endmodell (SEM) mit depressiven Symptomen als abhängige Variable hatte einen guten Modell-Fit ($\chi^2 = 45.10$, $p = .00$, $df = 23$, $\chi^2 / df < 2.5$, RMSEA = .056, CFI = .988) und klärte 67 % der Varianz der depressiven Symptome auf. Der Lebenssinn ($\beta = -.45$) und die kognitive Bewertung von Stressoren als „Verlust" ($\beta = .21$) standen in direktem Zusammenhang mit der Ausprägung der depressiven Symptome. Das Endmodell mit Lebensqualität als abhängige Variable hatte einen guten Modell-Fit ($\chi^2 = 59.94$, $p = .00$, $df = 24$, $\chi^2 / df < 2.5$, RMSEA = .069, CFI = .959) und klärte 70% der Varianz der Lebensqualität auf. Werte in der Lebenssinn-Skala standen im direkten Zusammenhang mit der Lebensqualität, wobei der Pfadkoeffizient auf eine große Wirkung hinweist ($\beta =$

.63). Der Einfluss der Selbstwirksamkeit auf die Lebensqualität wurde durch die kognitive Bewertung „Verlust" mediiert. Das Endmodell mit Partizipation als abhängige Variable hatte einen guten Modell-Fit (χ^2 = 37.17, p = .04, df = 24, χ^2 / df < 2.5, RMSEA = .042, CFI=.986) und konnte 19% der Varianz der Partizipation erklären. Die Selbstwirksamkeit stand in moderatem direkten Zusammenhang mit Partizipation (β = .29), während der Lebenssinn einen indirekten Einfluss auf Partizipation ausübte.

Die psychologischen Ressourcen Lebenssinn und Selbstwirksamkeit hängen mit der psychosozialen Anpassung signifikant zusammen, indem sie einen direkten Einfluss auf depressive Symptome, Lebensqualität und Partizipation ausüben. Die kognitive Bewertung „Verlust" hat eine zentrale Rolle in diesem Anpassungsmechanismus inne, während Bewältigungsstrategien eine untergeordnete Rolle zukommt.

Allgemeine Diskussion

Das Gesamtziel der vorliegenden Dissertation war es, ein vertieftes Verständnis zum psychosozialen Anpassungsprozess bei Menschen mit einer Rückenmarksverletzung (RMV) mit spezifischem Fokus auf psychologische Ressourcen zu erhalten.

Resultate des systematischen Literaturreviews (Studie 1), der Fallstudie (Studie 2) sowie der empirischen Studie (Studie 4) unterstreichen die wichtige Rolle von psychologischen Ressourcen im psychosozialen Anpassungsprozess nach einer RMV. Der systematische Literaturreview zeigte, dass gut ausgeprägte psychologische Ressourcen mit einer höheren Lebensqualität und besserer mentalen Gesundheit zusammenhängen. Die gezielte Einbeziehung von den psychologischen Ressourcen Neugier und Musikalität führte zu positiven Resultaten im klinischen Rehabilitationskontext, indem sie zur Stressreduktion eines Patienten beitrug. Der Patient fühlte sich dadurch besser verstanden und respektiert, was wiederum die Zusammenarbeit mit dem Gesundheitspersonal verbesserte. Die empirische Studie zeigte, dass die Selbstwirksamkeit und der Lebenssinn eine hohe Lebensqualität, mentale Gesundheit und Partizipation mitbestimmen, wobei der Einfluss von Lebenssinn der Stärkste aller Beobachteten Variablen war. Lebenssinn, Selbstwirksamkeit sowie Verlust als kognitive Bewertung spielten im psychosozialen Anpassungsprozess eine zentrale

Rolle. Bewältigungsstrategien (coping) hatten hingegen einen sehr begrenzten Einfluss auf die Anpassungsfolgen. Dies steht mit vergangenen Befunden, welche die Rolle kognitiver Bewertungen betonen, im Einklang, widerspricht jedoch Forschungsergebnissen, in welchen die Bewältigungsstrategien als wichtige Quelle und Determinante der psychosozialen Anpassung identifiziert wurden [20, 51]. Das Spinal Cord Injury Adjustment Model (SCIAM) ist nicht notwendigerweise eine korrektes Modell für die Beschreibung der psychosozialen Anpassung nach einer RMV, da kognitive Bewertungen und Bewältigungsstrategien nicht durchwegs als Mediatoren zwischen den psychologischen Ressourcen und den Anpassungsfolgen fungierten [36].

Gute psychometrische Eigenschaften wurden für die Skala der allgemeinen Selbstwirksamkeitserwartung gefunden. Allerdings könnte die Skala verkürzt werden, was die Belastung der Studienteilnehmer reduzieren und so möglicherweise die Antwortrate erhöhen könnte.

Insgesamt ist der Forschungsstand zu psychologischen Ressourcen bei Menschen mit einer RMV fragmentiert. Der Hauptfokus wurde bisher auf die Selbstwirksamkeit gelegt, sollte jedoch auf andere psychologische Ressourcen wie z.B. der Neugier ausgeweitet werden. Längsschnittstudien mit Start in der frühen Akutphase nach der RMV sind nötig, um Rückschlusse auf die Kausalität ziehen zu können. Nur wenige Studien untersuchten den Anpassungsprozess und den dahinterliegenden Mechanismus auf umfassende Weise. Die Validierung von Messinstrumenten unter Verwendung von modernen testtheoretischen Ansätzen sollte intensiviert werden, sodass reliable Messinstrumente für psychologische Ressourcen zur Verfügung stehen.

Die vorliegende Dissertation bietet unterstützende Belege für die Bedeutung von psychologischen Ressourcen bei Menschen mit einer RMV. Sie kann als Grundlage für die Entwicklung systematischer Interventionen dienen, welche die Stärkung psychologischer Ressourcen bei Menschen mit einer RMV zum Ziel haben.

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11. Appendix

Appendix 1. The Utrecht Scale for Evaluation of Rehabilitation-Participation (User-P), subscale.

Leisure-time activities

Does your spinal cord injury currently limit your daily life?

Not applicable: You do not take part in this activity, but this is not because of your spinal cord injury.

Not possible: You do not take part in this activity, and this is because of your spinal cord injury.

With assistance: You perform this activity partly by yourself, but need assistance because of your spinal cord injury. For example: You have a home help to perform heavy household duties, your family helps by taking you to places. This includes paid help and unpaid help from family or friends.

With difficulty: If because of your spinal cord injury this activity is considerably more difficult for you. For example: it takes much more time, you need to rest halfway through an activity, you now do it less frequently, for a shorter time or in a less taxing way.

		Not applicable	*Not possible*	*With assistance*	*With difficulty*	*Without difficulty*
1.	**Paid work, unpaid work or education**	○	○	○	○	○
2.	**Household duties** *e.g. cooking, cleaning, shopping, taking care of or supervising children, DIY, gardening*	○	○	○	○	○
3.	**Outdoor mobility** *e.g. driving a car, travelling by bus or train, going to work or shopping by hand-bike/wheelchair*	○	○	○	○	○
4.	**Sports or other physical activities** *e.g. tennis, hand biking, gym, long wheelchair drives*	○	○	○	○	○
5.	**Going out** *e.g. eating out, visiting a cafe, the cinema, a concert, alone or with others*	○	○	○	○	○
6.	**Day trips and other outdoor activities** *e.g. shopping, attending events, going to the beach, church or mosque*	○	○	○	○	○
7.	**Leisure activities at home** *e.g. crafts, needlework, reading, puzzles, playing computer games*	○	○	○	○	○
8.	**Your relationship with your partner** *e.g. communication, sexuality*	○	○	○	○	○

9.	**Visiting family or friends**	○	○	○	○	○
10.	**Being visited by family or friends**	○	○	○	○	○
11.	**Contacting others by phone or computer** *e.g. talking on the phone, texting, e-mailing*	○	○	○	○	○

Appendix 2. WHOQoL-Bref, selected items.

Quality of life

The following questions ask you to say how satisfied, happy or good you have felt about various aspects of your life over the last two weeks. Decide how satisfied or dissatisfied you are with each aspect of your life and circle the number that best fits how you feel about this.

12. How would you rate your quality of life?

Very poor	*Poor*	*Mediocre*	*Good*	*Very good*
○	○	○	○	○

		Very dissatisfied	*Dissatisfied*	*Neither satisfied nor dissatisfied*	*Satisfied*	*Very satisfied*
13.	**How satisfied are you with your health?**	○	○	○	○	○
14.	**How satisfied are you with your ability to perform your daily living activities?**	○	○	○	○	○
15.	**How satisfied are you with your personal relationships?**	○	○	○	○	○
16.	**How satisfied are you with the conditions of your living place?**	○	○	○	○	○

Appendix 3. The General Self-Efficacy Scale.

Belief in own abilities

Please read each statement carefully and mark the box for the answer that describes you best.

		Not at all true	*Hardly true*	*Moderately true*	*Exactly true*
17.	**I can always manage to solve difficult problems if I try hard enough.**	○	○	○	○
18.	**If someone opposes me, I can find the means and ways to get what I want.**	○	○	○	○
19.	**It is easy for me to stick to my aims and accomplish my goals.**	○	○	○	○
20.	**I am confident that I could deal efficiently with unexpected events.**	○	○	○	○
21.	**Thanks to my resourcefulness, I know how to handle unforeseen situations.**	○	○	○	○
22.	**I can solve most problems if I invest the necessary effort.**	○	○	○	○
23.	**I can remain calm when facing difficulties because I can rely on my coping abilities.**	○	○	○	○
24.	**When I am confronted with a problem, I can usually find several solutions.**	○	○	○	○
25.	**If I am in trouble, I can usually think of a solution.**	○	○	○	○
26.	**I can usually handle whatever comes my way.**	○	○	○	○

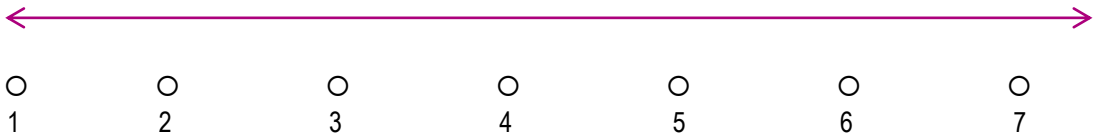
Appendix 4. Purpose in Life Scale – Short Form (PIL-K).

Life goals

The following questions each consist of two opposite statements about life goals and meaning in life. The numbered boxes represent the steps between these opposites. Please mark the box that describes best your view right now.

27. In life I have:

No goals or aims — *Very clear goals and aims*



○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

28. My personal existence is:

Utterly meaningless, without purpose — *Very purposeful and meaningful*

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

29. In achieving life goals I've:

Made no progress whatever — *Progressed to complete fulfillment*

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

30. I have discovered:

No mission or purpose in life — *Clear-cut goals and a satisfying life purpose*

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

Appendix 5. Brief COPE.

Handling stressful life situations

The following statements are about how you've been dealing with stressful situations in your life. There are many ways to try to cope with problems. We are interested in how you have tried to deal with it. Each sentence says something about a particular way of coping. We would like to know to what extent you've been applying the particular way of coping. Don't answer on the basis of whether it seems to be working or not -- just whether or not you're doing it.

		Not at all	*A little bit*	*Medium amount*	*A lot*
31.	**I turned to work or other activities to take my mind off things.**	○	○	○	○
32.	**I concentrated my efforts on doing something about the situation I was in.**	○	○	○	○
33.	**I said to myself "this isn't real".**	○	○	○	○
34.	**I used alcohol or other drugs to make myself feel better.**	○	○	○	○
35.	**I got emotional support from others.**	○	○	○	○
36.	**I gave up trying to deal with it.**	○	○	○	○
37.	**I took action to try to make the situation better.**	○	○	○	○
38.	**I refused to believe that it had happened.**	○	○	○	○
39.	**I said things to let my unpleasant feelings escape.**	○	○	○	○
40.	**I got help and advice from other people.**	○	○	○	○
41.	**I used alcohol or other drugs to help me get through it.**	○	○	○	○
42.	**I tried to see it in a different light, to make it seem more positive.**	○	○	○	○
43.	**I criticized myself.**	○	○	○	○
44.	**I tried to come up with a strategy about what to do.**	○	○	○	○
45.	**I got comfort and understanding from someone.**	○	○	○	○
46.	**I gave up the attempt to cope.**	○	○	○	○

		Not at all	*A little bit*	*Medium amount*	*A lot*
47.	**I looked for something good in what was happening.**	○	○	○	○
48.	**I made jokes about it.**	○	○	○	○
49.	**I did something to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping or shopping.**	○	○	○	○
50.	**I accepted the reality of the fact that it happened.**	○	○	○	○
51.	**I expressed my negative feelings.**	○	○	○	○
52.	**I tried to find comfort in my religion or spiritual beliefs.**	○	○	○	○
53.	**I tried to get advice or help from other people about what to do.**	○	○	○	○
54.	**I learned to live with it.**	○	○	○	○
55.	**I thought hard about what steps to take.**	○	○	○	○
56.	**I blamed myself for things that happened.**	○	○	○	○
57.	**I prayed or meditated.**	○	○	○	○
58.	**I made fun of the situation.**	○	○	○	○

Appendix 6. Hospital Anxiety and Depression Scale (HADS), depression subscale.

Mood

Please read each of the following statements carefully and mark the box for the response that describes best how you have felt the past week.

59. I still enjoy the things I used to enjoy.

- ○ Definitely as much
- ○ Not quite so much
- ○ Only a little
- ○ Hardly at all

60. I can laugh and see the funny side of things.

- ○ As much as I always could
- ○ Not quite so much now
- ○ Definitely not so much now
- ○ Not at all

61. I feel cheerful

- ○ Not at all
- ○ Not often
- ○ Sometimes
- ○ Most of the time

62. I feel as if I am slowed down.

- ○ Nearly all the time
- ○ Very often
- ○ Sometimes
- ○ Not at all

63. I have lost interest in my appearance.

- ○ Definitely
- ○ I don't take as much care as I should
- ○ I may not take quite as much care
- ○ I take just as much care as ever

64. I look forward with enjoyment to things.

- ○ As much as I ever did
- ○ Rather less than I used to
- ○ Definitely less than I used to
- ○ Hardly at all

65. I can enjoy a good book or radio or TV program.

- ○ Often
- ○ Sometimes
- ○ Not often
- ○ Very seldom

Appendix 7. Appraisal of Life Events Scale (ALE).

Perception of difficult life situations

Please think of difficult situations that you have experienced in the last three months. We would like you to rate your perceptions of these difficult events. Please indicate the extent to which each of the words best describes your perceptions of the situations when they occurred. Please mark the appropriate box.

I perceived the difficult situations as…	*Not at all* ← → *Very much so*					
66. threatening	○	○	○	○	○	○
67. fearful	○	○	○	○	○	○
68. enjoyable	○	○	○	○	○	○
69. worrying	○	○	○	○	○	○
70. hostile	○	○	○	○	○	○
71. challenging	○	○	○	○	○	○
72. stimulating	○	○	○	○	○	○
73. exhilarating	○	○	○	○	○	○
74. painful	○	○	○	○	○	○
75. depressing	○	○	○	○	○	○
76. pitiful	○	○	○	○	○	○
77. informative	○	○	○	○	○	○
78. exciting	○	○	○	○	○	○
79. frightening	○	○	○	○	○	○
80. terrifying	○	○	○	○	○	○
81. intolerable	○	○	○	○	○	○